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Met O 3 Technical Note No. 1

LONG-TERM OPTIMUM AVERAGING PERIODS FOR TEMPERATURES IN THE UNITED KINGDOM

by

S G Smith

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SUMMARY

An index has been formulated to assist in the determination of the long term optimum averaging period for mean maximum and mean minimum temperatures in the United Kingdom. The results are based on 95 years of data at five well separated stations. The optimum length has been found to depend on a number of factors and reasons for these variations have been investigated.

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1. Introduction

The World Meteorological Organisation (1976) currently recommend that a 30 year normal, or averaging period (AP), be used for climatological purposes. This study investigates whether the 30 year period is the best AP to use for temperatures in the United Kingdom, at the same time obtaining an indication of likely errors resulting from the use of AP's of any length between 5 and 50 years.

Previous workers on this subject include Enger (1959), Craddock and Grimmer (1960) and Court (1967-68). Enger studied daily and monthly mean temperatures for stations in the United States and Craddock and Grimmer analysed annual mean temperatures for selected stations in the Northern Hemisphere. Both papers suggested that an AP somewhat less than 30 years may be preferable, particularly where records are not homogeneous. Court investigated averaging periods for temperature, sunshine and precipitation for several stations in the United States and for others over the Northern Hemisphere. He found that, averaged over all elements, stations and months, all AP's between 10 and 40 years long were in general equally suitable.

In the United Kingdom (UK) many stations do not have data in computer accessible form extending back as long as 30 years and for others the records are not homogeneous for this length of time. If the use of AP's less than 30 years gives satisfactory values more stations can be employed to answer climatological enquiries.

2. Discussion

2.1 The problem

In most applications, AP means are required as an attempt to forecast future conditions. The climate of years comprising the AP is implicitly assumed to be representative of the climate of years in the future. However it is well known that climate varies even on the scale of decades (see for example Lamb (1977)) and hence 30 years may be too long a period from which to extrapolate expected conditions. Reducing the length of AP, however, could result in the AP mean having an unacceptably high variability. A detailed description of the issues involved in determining a suitable climatological AP is given in a World Meteorological Organisation technical note (WMO, 1967).

For the present, reference to the optimum averaging period is taken to imply the AP which comes nearest to satisfying the desire to obtain a value representative of future conditions and the desire to maximise the precision of the estimate.

2.2 Terminology

The optimum averaging period is dependent on a number of factors and some of the terms representing these factors are defined:

(i) PARAMETER: the observed variable. Means of daily maximum and means of daily minimum temperatures (referred to as maxima and minima) will be considered.

(ii) TIME AVERAGE: the period over which the parameter is averaged. 10-day, monthly, seasonal and annual time averages will be studied.

(iii) FORECAST PERIOD: the number of years in the future over which the AP estimate is required, namely 3, 5, 10 and 20 years for this study. (Note that this term is used in a rather different sense to usual Meteorological Office practice)

3. Data

3.1 Stations and Means

Only stations with a reasonably continuous temperature record of the order of 100 years were suitable for this study. It was also desirable that the data be as homogeneous as possible. About 10 stations in the UK have observations that satisfy these criteria and whose data were available in a suitable computer compatible format. Of these, five were selected to cover as wide an area of the UK as possible. These five, with the abbreviations used for each in the tables and their grid references are:

Armagh (Arm; IH(23) 878458), Durham (Dur; NZ(45) 267416),
Gordon Castle (Gor; NJ(38) 350595), Oxford (Oxf; SP(42) 509072),
and Plymouth (Ply; Hoe SX(20) 478537 and Mountbatten SX(20) 492529) -

see fig 1 for locations. (The reasons for utilizing data from two sites at Plymouth are given in 3.1.1). These five stations will be referred to as the principal stations.

Each principal station has daily maxima and minima for the period 1882-1976, with the exception of Gordon Castle which closed in July 1975 (reference to the period 1882-1976 will therefore imply 1882 to June 1975 for Gordon Castle). Monthly mean maxima and monthly mean minima were calculated over the period 1882-1976 provided that no more than five daily values and no more than two consecutive daily values were missing in that month. Only the December 1883 maxima and minima at Durham and the October 1956 minima at Gordon Castle were not calculable using these criteria. The missing Durham values were estimated using the method of differences with Sheffield Western Park (SK(43) 339873) and the missing Gordon Castle value by the same method with Forres, 30 km to the west of Gordon Castle (Sheffield and Forres are shown in fig 1).

Seasonal maxima and minima and an annual mean were then derived from the monthly maxima and minima for each station.

Ten-day mean maxima and minima were derived for Oxford from daily values such that three 10-day means were calculated from the first 30 days of each month (except February for which three 9-day means were derived from the first 27 days of that month).

Average temperatures over the five principal stations were then calculated, to provide temperatures representative of the UK as a whole, for monthly maxima and minima, seasonal maxima and minima and the annual means.

Monthly mean Central England temperatures for the period 1723-1976 presented by Manley (1974) and updated since 1973 by Jenkinson were also employed so that results from a long, homogeneous record could be compared with the shorter length records from individual stations which may be subject to local transient effects.

To allow comparison of results for two nearby stations, monthly maxima and minima for Sheffield and Bradford (SE(44) 149352) - shown in fig 1) were also computed from daily values for the period 1908-1976. It was only possible to compare values for 1908-1976 because temperature records for Bradford were not available in a suitable computer compatible format before 1908.

A list of all the stations and means used is given in Table I.

3.1.1 Station characteristics

This section describes, for the principal stations, changes in site or in site characteristics which may have affected the homogeneity of their data.

(i) Armagh

No record of site changes at Armagh exists. However personal communication with Belfast Meteorological Office in 1977 indicates that at that time "action was being taken to cut down vegetation which had grown to excess and was providing shelter to an unacceptable limit".

(ii) Durham

The site was moved by six metres in 1961 but this is unlikely to have affected the homogeneity of the data. However Manley (1941) suggested that monthly maxima and minima at Durham between 1922 and 1933 were too low by amounts ranging from 0.1°F to 0.8°F (0.06°C to 0.44°C).

(iii) Gordon Castle

Records of the site at Gordon Castle are only available since 1908. No changes in site occurred from 1908 until the station closed in 1975. To examine whether the missing values for the end of 1975 and 1976 might have an important effect on results, comparison of results for Oxford and Armagh for the period 1882-1974 were made with results for 1882-1976. Differences were found to be negligible.

(iv) Oxford

The site at Oxford has changed twice during the period 1882-1976 but it has always remained within the confines of the Radcliffe Observatory. However Manley (1974) suggested that the Radcliffe Observatory at Oxford "...since 1935 shows signs of the growing effect of urbanisation and slight changes of site."

(v) Plymouth

The data for Plymouth is a combination of data from two sites: the Hoe between 1882 and 1930 and Mount Batten between 1931 and 1976. No other suitable station was available for SW Britain. Although Plymouth Hoe has submitted temperatures throughout the period 1882-1976, the data since 1930 were not in a computer compatible form and twice since 1930, in 1937 and 1950, inspectors' reports state that the site at the Hoe was "unsatisfactory". Several minor changes of site have occurred at Mount Batten since 1930. Also between November 1946 and July 1948 the station was closed and for this period observations were used from Mount Wise, 1½ km to the west of Plymouth Hoe. The most significant change of site, however, is the change in 1930 from the Hoe, which is in comparatively sheltered surroundings, to Mount Batten, where the instruments are situated in an exposed site on the crest of a hill.

3.2 Data characteristics

To try and identify factors affecting the length of optimum averaging period (OAP), four characteristics of the data were studied: variability, features peculiar to each station, irregular climatic fluctuations and oscillations.

3.2.1 Variability

If data have a large year-to-year variability then many years are required to provide a stable estimate based on the mean of those years. Therefore data having a high variability would be expected to have a relatively long OAP and vice-versa.

The standard deviations for 10-day maxima and minima (9-day in February) at Oxford, and for monthly and seasonal maxima and minima and for annual means, at the principal stations, are shown in Table II. The variability is seen to decrease with increase in time average length. Minima are less variable than maxima except during some late autumn and winter months. However at Plymouth minima are more variable from October through to April whereas at Gordon Castle minima are less variable throughout the year. For maxima, Oxford has the most variable data with Armagh and Plymouth having the least variable. The relationship between station and variability for minima is more complex.

3.2.2 Features peculiar to station

An objective scheme was derived for determining individual years or periods of years for which temperatures from a particular station were anomalously low or high compared to temperatures at the other principal stations. For each station and month and for maxima and minima separately the differences for the temperatures of each year from 1882 to 1976 from the 1882-1976 mean were compared with corresponding differences for the temperatures at the other stations. It was found that, relative to the other stations,

(i) Armagh maxima were warm and minima were cool from 1960 to 1976.

(ii) Durham maxima and minima were cool in the 1920's.

(iii) Gordon Castle maxima and minima were warm in the 1880's.

(iv) Plymouth maxima and minima were warm till 1930 and minima were cool after 1930.

It is not known whether (iii) is due to features of the site. However (i), (ii) and (iv) tend to support the comments made for these stations in 3.1.1.

3.2.3 Irregular climatic fluctuations

If marked (irregular) climatic fluctuations exist in the data, temperatures well into the past are not representative of temperatures observed later. Such data would therefore be expected to have a relatively short OAP. The same is true for inhomogeneous data (provided inhomogeneities do not counteract the effects of climatic fluctuations). Work done by Court (1967-68, part 1) using simulated data supports these intuitive arguments.

The existence of significant differences between the means of intervals of years within the 1882-1976 period was deduced from an analysis of variance run on the data. Oxford and Armagh monthly maxima and minima were studied. The 95 year record was divided into five non-overlapping 19 year intervals and the analysis of variance technique was used to determine the percentage probabilities of the differences between means of the five intervals occurring by chance. Results are shown in Table III. The differences between means are most significant in April and October. The results for minima are more significant, in general, than those for maxima while for maxima those at Armagh are more significant than at Oxford.

The cumulative differences from the 1882-1976 mean for selected months at Oxford were plotted to display the presence of climatic fluctuations. Fig 2A shows the results for maxima. Negative gradients represent cool periods and positive gradients warm periods, relative to the 1882-1976 mean. For all months except January a warming begins after 1940. In January a cooling begins after 1940. October displays a marked cool period between 1882 and 1896. The same features are apparent for minima (shown in fig 2B) as for maxima, although April minima are predominantly cool between 1882 and 1920 and for October the warming begins some 20 years later than for maxima.

The effect of climatic fluctuations with regard to AP estimates is shown for April maxima at Oxford in fig. 3. The plot gives differences between forecast period means of 10 years and AP means of 30 years (against the year 1911 is the mean for 1912-1921 minus the mean for 1882-1911 and so on for each year until 1966). For all years between 1912 and 1924 and again between 1952 and 1966 the AP mean overestimates (as indicated by the negative value) the forecast period mean, whereas between 1930 and 1940 the converse is true.

3.2.4 Oscillations

The presence of well marked oscillations in the data should result in an OAP close to the period of the oscillations. This was supported by an analysis run on random Normal data superimposed by oscillations of fixed period and amplitude.

Dyer (1976) has analysed Manley's Central England temperatures by months for the period 1659 to 1973. He observed some significant oscillations but the lengths of their periods tended to vary with month of year.

The existence of oscillations in monthly maxima and minima over the period 1882-1976 was tested for by applying a power spectrum analysis available in the Biomedical Computer Programs' statistical package (Dixon, 1974). January, April, July and October maxima and minima were investigated for Oxford and Armagh. The analysis calculated the proportions of variance accounted for by cycles of periods 2 to 100 years, with greater resolution for the shorter periods. No particular cycles overall accounted for significantly high proportions of the total variance and for many months even the largest proportions were not significantly different from random noise (at the 5% level).

An autocorrelation analysis was also performed on data for all months, for Oxford and Armagh, to investigate the existence of significant lags. Significant lags were obtained but for no more than two months out of 12 for each station and some significant lags would be expected to occur purely by chance.

It is concluded that if cycles do exist they are either too weak to be important or else are only significant for very limited periods of the year.

4. Methods for determining the "best" estimate

A number of methods can be employed for estimating future temperatures based on past observations. Similarly a variety of methods exist for evaluating the performance of each estimate. The choice of either type of method could depend on the relative ease of computation, the data available and the requirements of the estimate. Section 4.1 describes methods for deriving an estimate and section 4.2 investigates methods for evaluating the performance of the estimate.

4.1 Methods for obtaining an estimate

(i) Averaging period mean

The estimate is the unweighted arithmetic mean of a given number of years, namely the length of the AP. This is a particularly simple form of a regression equation in which each coefficient equals the reciprocal of the length of the AP. The methods described under (ii) and (iii) examine whether more complicated forms of regression equation are more appropriate for forecasting future temperatures based on temperatures observed in previous years.

(ii) Unspecified regression equation

One might expect that if an estimate is required for, say, the period 1971-1980 then more weight should be given to temperatures recorded in the 1960's than in the 1940's. To study this, linear regression and stepwise regression routines available in the Biomedical Computer Programs' statistical package (Dixon, 1975) were applied to Oxford and Armagh monthly maxima and minima with forecast periods of 3 and 10 years. The number of regression variables in the regression equation, corresponding to the number of years comprising the AP, ranged from 10 to 30 years. The values for the coefficients were found to vary considerably between months and between stations and depended on the number of regression variables.

(iii) Exponential Smoothing

Exponential smoothing gives a particular form of regression equation in which weights applied to different years decrease exponentially with time into the past. The method has been employed by Craddock and Grimmer (1960) and Craddock (1967) to provide estimates of mean temperatures, and by Craddock (1976) to provide estimates of mean rainfall. The first two articles indicated that, in general, estimates produced by exponential smoothing techniques were no more accurate than simple arithmetic means. The third article did not compare the performance of estimates based on exponential smoothing with arithmetic means.

The results of exponential smoothing were compared with those of arithmetic means for Oxford and Armagh monthly maxima and minima (details omitted). It was found that only in a small minority of cases did the most accurate estimate based on exponential smoothing improve on the most accurate estimate derived from arithmetic means.

The conclusion from (ii) and (iii) is that there is little if any evidence to suggest that applying a regression equation (including exponential smoothing) would improve the accuracy of the estimates given by the simple unweighted mean of the OAP.

(iv) Median

For the purposes of this type of study, using the median, or central, value of the AP observations as the estimate has the advantage that it requires little computation and is unaffected by extremes. Its performance in estimating future temperature and precipitation values has been compared with that of the mean by Court (1967-68). He concluded that "prediction based on the median had slightly less error than that using the mean". To keep the present study within reasonable limits, however, it has been necessary to restrict analysis to mean estimates only.

4.2 Verification statistics

(i) Root-mean-square (rms) errors

This method was used by Enger, and Craddock and Grimmer. Let m estimates of temperature be denoted by C_1, C_2, ..., C_m and corresponding observed values by O_1, O_2, ... O_m.

Let e_1, e_2, ...e_m be the differences of these two quantities i.e. $e_j = O_j - C_j$. Then the rms error, R, of the estimates is given by

$$R = \sqrt{\frac{1}{m} \sum_{j=1}^{m} (O_j - C_j)^2} = \sqrt{\frac{1}{m} \sum e_j^2}$$

This method of evaluation does not distinguish between random errors of estimation and systematic errors. The latter could occur if there is a linear trend through the length of record - the estimates would then consistently under - or over-estimate observed values, giving a non-zero mean error ($\bar{e}_j$ significantly different from zero). The mean error is in fact above 0.5°C for some cases considered in this study.

(ii) Standard errors

In the notation of (i) the standard error, S, of the differences between estimated and observed values is given by

$$S = \sqrt{\left\{ \frac{1}{m-1} \left(\sum_{j=1}^{m} e_j^2 - \frac{\left(\sum_{j=1}^{m} e_j \right)^2}{m} \right) \right\}}$$

S is a measure of the variability of the differences. Calculation of S and $\bar{e}_j$ using estimates derived from AP means of 5 to 50 years and observed values derived from forecast period means of 3, 5, 10 and 20 years showed that a small value of S was not necessarily associated with a small value of $\bar{e}_j$. A statistic which incorporates both the standard error and mean error would therefore be more satisfactory.

(iii) Successive large differences of the same sign

Large differences of the same sign between estimated and observed values in consecutive years may have serious consequences for those involved in weather sensitive concerns. A requirement for an estimate of future temperatures could be that such occurrences are minimised i.e. that the number of occasions when e_j and e_{j+1} (where j = 1 to m - 1) are both greater than t°C, or both less than -t°C, is minimised.

Other methods of verification, such as the mean absolute error, also exist but are not developed here.

5. Methods of analysis

Section 4.1 suggested that arithmetic means are capable of providing satisfactory estimates of future temperatures compared to other, more complicated, techniques. A method for evaluating the performance of the different AP's is therefore required, taking into account points raised in 4.2.

5.1 Formulation of index

For each set of temperatures of length n, the mean differences and standard error of the differences between the AP and forecast period means were calculated. The AP of length N ranged from 5 to 50 years and the forecast period T equalled 3, 5, 10 and 20 years in turn.

The first difference, or error, equalled the mean of the first N years of the record subtracted from the mean of the next T years. The second difference equalled the mean of the second to the (N+1)th year of the record subtracted from the mean of the (N+2)th to the (N+T+1)th year, and so on through the length of record. This gives a total of n-N-T+1 differences for which the mean and standard error are calculated (with n = 95 this gives the total ranging from 88 when N=5 and T=3 to 26 when N=50 and T=20).

The mean M and standard error S of the differences are given by

$$M = \frac{1}{m} \sum_{j=1}^{m} \left(\bar{X}_{j,T} - \bar{X}_{j,N} \right)$$

$$S = \sqrt{\left\{ \frac{1}{m-1} \left(\sum_{j=1}^{m} \left(\bar{X}_{j,T} - \bar{X}_{j,N} \right)^2 - \frac{\left[\sum_{j=1}^{m} \left(\bar{X}_{j,T} - \bar{X}_{j,N} \right) \right]^2}{m} \right) \right\}}$$

where m = number of differences = n - N - T + 1

$\bar{X}_{j,T}$ denotes the jth forecast period mean of length T years

$\bar{X}_{j,N}$ denotes the jth AP mean of length N years.

For an optimum averaging period (OAP) it is desirable that both M and S be a minimum.

The following index, I, which is a function of M and S, was formulated to assist in the determination of the OAP:

$$I = \left[\left(1 - \Phi \left(\frac{t-M}{S} \right) \right) + \Phi \left(\frac{-t-M}{S} \right) \right] \times 100$$

where t is a constant and Φ denotes the normal probability function. I is the expected number of differences (expressed as a percentage of the total) between forecast mean and AP mean of greater than t°C. It corresponds to the probability that differences are greater than t°C plus the probability that differences are less than -t°C. This interpretation is valid only if differences are approximately normally distributed. To test this, values of skewness and kurtosis for the differences for monthly maxima and minima were calculated. The values obtained were within the 95% limits under the hypothesis that the distribution of differences formed a normal distribution.

It was found that for monthly means t = 0.75°C gave approximately the greatest range of I over all AP's. Since 10-day means are more variable than monthly means, t was set to 1.0°C for this time average. It was set to 0.5°C for seasonal means and to 0.25°C for annual means since these are less variable than monthly means. Varying the value of t does not alter the relative performance of each AP.

5.2 Interpretation of results

The observed percentage of differences for which the forecast period and AP means differ by more than t°C was calculated and compared with corresponding values of I. The differences between the observed percentages and I were generally less than 10%. The value of I is therefore a satisfactory indicator of the accuracy of AP means. Also its value depends on two statistics, namely the mean and standard error of the differences, which are themselves important.

As an example of the interpretation of I, for monthly means (when t = 0.75°C), I = 30 implies that (subject to sampling error) 30% of the differences between forecast period and AP means are greater than 0.75°C. The interpretation for other time averages is the same except that the value of t is changed.

5.3 Comparison with other methods

It was found that the AP giving the least value of I is generally within 5 years of the AP giving the least standard error of differences and the AP giving the least rms differences. The greatest differences in AP's between the methods occur when the mean difference rises steadily above about 0.1°C with increase in AP; in these cases the AP giving the least value of I is shorter than the AP giving the least value of the other statistics.

In section 4.2 it was suggested that it is sometimes desirable to minimise the occurrence of successive large differences of the same sign between estimated and observed temperatures. To investigate the usefulness of I in satisfying this criterion, means of AP's ranging from 5 to 50 years were compared with forecast period means of 10 years for Oxford monthly maxima and minima and the percentage number of successive differences exceeding 0.75°C with the same sign were calculated. The AP's giving the least percentages were generally within 2-3 years of the AP giving the least value of I. Hence the suitability of AP's using I as the criterion closely matches their suitability under this "successive large errors" criterion.

5.4 Properties of the index

Series of simulated temperatures using different models were generated so that properties of the index could be investigated on a large quantity of data. Two types of model were employed:

i. An autoregressive model of order one i.e. $x_t = \phi x_{t-1} + \epsilon_t$ where x_{t-1}, x_t are successive terms of the series, ϕ is a parameter and ϵ_t are, in this case, random normal deviates with mean zero and standard deviation one.

ii. A moving average model of order one i.e. $x_t = \epsilon_t - \theta \epsilon_{t-1}$ where θ is a parameter and the other terms are as defined in (i).

By varying the values of ϕ and θ, series having different characteristics were generated. For each value of ϕ and θ, 100 series of 95 terms were produced and the mean and standard deviation of I over these 100 series were calculated for each AP of lengths 5 to 50 years. It was found that

a. In all cases when the lower and upper bounds of possible values of I did not limit the range of I observed, the standard deviation of I was about two to three times as large for the longest AP's compared to the shortest.

b. The greater the persistence between successive terms of the series (corresponding to positive ϕ in the autoregressive model) the larger the value of the index and the better the performance of the short AP's in relation to the longer AP's.

c. The greater the degree of anti-persistence (corresponding to negative ϕ or positive θ) the smaller the value of the index and the worse the performance of the short AP's compared to the longer AP's.

The actual temperature series used in this study have different persistence characteristics and so these findings can assist in the interpretation of variation of I with AP for the real data.

6. Results

6.1 Definition of optimum averaging period (OAP)

Fig 4 shows the variation of I with AP for Oxford winter and summer maxima. Frequently, as in these two cases, there is more than one local minimum or there are several consecutive AP's giving almost the same minimum value. In these cases presenting a single AP as the "optimum" could be misleading. Subsequent reference to the OAP will refer to the central value of AP's for which I is within 5% of the minimum value of I for AP's between 5 and 50 years.

6.2 Comparison of results for Sheffield and Bradford

To ascertain whether observed differences in OAP between the principal stations are not simply due to random variations, a comparison was made between values of I for monthly maxima and minima for Sheffield and Bradford. These stations are only 50 km apart, both are on the Eastern side of the Pennines and there is only 3 metres difference in altitude between the two sites.

Results for January and July maxima and minima are shown in Figs 5A and 5B. The shapes of the curves for the two stations are generally similar and their OAP's are approximately the same (although there are AP's for which the actual magnitude of I is different). This suggests that the effect of random variation will only produce small changes in OAP.

6.3 Summary of results

Table IV presents the value of I against every fifth AP for 10-day maxima and minima at Oxford. Tables V(a) to V(q) give corresponding values for monthly, seasonal and annual means for all principal stations and the UK temperature series. Results are given for forecast periods of 3, 5, 10 and 20 years. Figs 6A and 6B show the variation of I with AP for selected months at Oxford, forecast period 10 years. Figs 7A and 7B display, for every fifth AP, the differences between I and the minimum value of I for AP's between 5 and 50 years, for Oxford monthly maxima and minima, forecast period 10 years. AP's frequently giving values less than 5 can be considered as suitable OAP's whereas those frequently giving values greater than 15 are generally to be avoided. (The values of 5 and 15 selected are arbitrary).

Salient features of these tables and figures will be described or alluded to under the following headings (on which the OAP has been considered to depend):

(i) Time of year

(ii) Time average

(iii) Parameter

(iv) Forecast period

(v) Station

(vi) Period of data

The accuracy of the AP estimates (as measured by the magnitude of I) and the OAP itself will be considered under these headings.

(i) Time of year

Both the OAP and its accuracy vary considerably through the year. Table V reveals that Autumn generally gives the most accurate estimates, except for long AP's in October where the accuracy is poor. Winter periods give the least accurate estimates.

Fig 7A shows how the OAP varies with month at Oxford for monthly maxima. An AP of length 15-20 years is suitable as an OAP in January, February, April and from August to October but is unsatisfactory in March, May and December, for which longer AP's are required. Differences between months are also evident for minima displayed in fig 7B. In terms of seasons (Table V), Spring and Autumn give the shortest OAP's, followed by Winter, with the longest OAP's occurring in Summer.

The relatively short OAP's in Spring and Autumn are a consequence of the climatic fluctuations particularly evident in April and October, together with the relatively low variability at these times of the year (see section 3). The poor accuracy for long AP's in October is also a result of these climatic fluctuations, whereas the poor accuracy evident for Winter periods is due to the high variability of the temperatures at that time of the year.

(ii) Time average

Direct comparison of the accuracy between time averages is not possible owing to the different values of t for each time average.

The longest OAP's tend to occur with 10-day means. Monthly means and seasonal means give OAP's about 10 years and about 20 years shorter than 10-day means, respectively. For all stations except Oxford the shortest OAP's occur with annual means, some 25 years shorter than 10-day means.

The decrease in OAP with increase in time average is associated with the corresponding decrease in variability of the data.

(iii) Parameter

Minima tend to give more accurate estimates than maxima in the Spring and Summer periods of the year whereas in Autumn and Winter the reverse is true.

For OAP's, minima give values about 5 years shorter than maxima, though exceptions such as September minima giving values about 20 years shorter than maxima, do occur.

The result for the accuracy of the estimates agrees with the finding that minima are generally less variable than maxima throughout Spring and Summer. Climatic fluctuations are more evident for minima than maxima and this is the likely cause of the shorter OAP for minima.

(iv) Forecast period

The accuracy of the AP estimate improves as the forecast period increases (forecast period as defined in 2.2), except for a few occasions in Spring and Autumn and also for the annual mean. The exceptions occur because the increased effect of climatic fluctuations in the data counteracts the effect of reduced variability.

The range of OAP is greatest for the short forecast periods (owing to the high variability of short forecast period means). For the majority of cases the OAP increases with increase in forecast period although where well developed fluctuations exist, as in April and October, the OAP decreases as forecast period increases.

(v) Station

No station overall gives less accurate or more accurate estimates than the other stations. However for particular cases the accuracy differs considerably from station to station e.g. for October minima (see table V (j)), forecast period 20 years and AP 50 years, I is very large (> 90) at Gordon Castle, Durham and Armagh but relatively small (< 35) at Oxford and Plymouth.

The OAP, in most cases, does not vary by more than 10 years from station to station. A major exception to this occurs for maximum temperatures during the months of April and October and the seasons of Spring and Autumn, for which the OAP at Plymouth is about 20 years longer than at the other stations. This is probably a result of the site change at Plymouth in 1930 counteracting the effect of climatic fluctuations. Evidence that this site change has introduced some degree of inhomogeneity into the Plymouth data is revealed by plots of cumulative differences from 1882-1976 means for April and October maxima. The plots for April maxima are shown in fig 8A. At Plymouth the temperatures are relatively uniform between 1882 and 1976 whereas at the other stations the period before 1940 is cooler (corresponding to a negative gradient of the curve) than the period after 1940 (where the gradient is positive). Fig 8B shows a similar result for October maxima, though in this case a cooling is more marked in the 1890's.

There is a tendency for the OAP at Gordon Castle and Durham to be about five years shorter, on average, than at Oxford and Plymouth. This difference is most evident for seasonal minima; it may be due to climatic fluctuations being more prominent in the north than further south.

The results for monthly Central England temperatures over the period 1882-1976 (fig 9A) are similar to the results for monthly maxima and minima at individual stations. This suggests that large scale climatic effects have been more important than local effects in influencing the length of OAP.

(vi) Period of data

The above results relate to data from the period 1882-1976. The validity of these results for a longer length of record and for different periods was examined using the time series of Central England temperatures.

Values of I were firstly derived for monthly mean temperatures over the period 1723-1976. For this series, investigation of AP's of length 5 to 100 years was possible owing to the greater number of years of data. The results are shown in fig 9B as differences from the minimum value of I over this extended AP range. It is seen that the OAP could reasonably be taken as any length of AP greater than about 35 years. For January and October AP's longer than 70 years are unsuitable but in some cases, such as the three summer months, AP's as long as 100 years are perfectly adequate. This tendency for longer OAP's suggests that the temperature fluctuations observed in the 1882-1976 period are in general of short duration compared to the length of the 1723-1976 period.

Values of I were next derived for monthly means over three 84 year periods viz (i) 1725-1808, (ii) 1809-1892, and (iii) 1893-1976, and results compared. These for January and July are shown in figs 10A and 10B respectively. For both months there is a reasonable similarity for the values of I between the different periods. The results for October are displayed in fig 10C as a contrast to those of January and July. In this case there are considerable differences between periods. The same is also true for April (not shown).

To obtain some indication of the suitability of different AP's based on results from all three periods the following procedure was adopted: for each month AP's were classified according to the differences between I and the minimum for AP's between 5 and 40 years (40 years was chosen as the upper limit because longer AP's are of lesser practical importance and where marked minima occur at 50 years results for other AP's are distorted if 50 years is the upper limit). The classifications were

i. differences all less than 5 (for the three periods)

ii. one or two of the three differences greater than 10

iii. all three differences greater than 10.

Fig 11 shows the results of this analysis. For April and October, where there were substantial differences between periods, no AP falls into class (i). There are considerable differences between months but AP's less than 10 years are unsatisfactory for all times of the year. December, January, August and September are associated with the shortest suitable AP's. The only AP's which do not fall into either of the classes (ii) or (iii) are of length 28-33 years, for which about one third of the months fall into category (i). This suggests an AP of about 30 years is the most suitable agreeing with the overall conclusions for monthly temperatures between 1882 and 1976.

The results for 1882-1976 are more likely to be valid for temperatures in succeeding years than the results for earlier periods (assuming no marked cyclic variation of temperature of the appropriate order). It is to be expected, however, that at some time in the future, results from this 1882-1976 period will need to be updated due to the (as yet unknown) climatic fluctuations occurring after 1976.

7. Conclusion

An index has been formulated which assists determination of the optimum averaging period (OAP) and allows quantitative assessment of the suitability of any length of averaging period. It has been applied to mean maximum and mean minimum temperatures at five widely scattered stations in the United Kingdom.

It has been found that the OAP varies considerably with the time of year and with time average. It varies to a lesser extent with forecast period, with station and between maxima and minima. Analysis of the Central England monthly temperature series also shows that the OAP is affected to some extent by the period of data and the length of data used. Reasons for the variations have been sought and it has been deduced that the variability of the data and magnitude of climatic fluctuations in the data are important factors.

For the 1882-1976 period at individual stations, the longest OAP's (greater than 45 years) occur with 10-day mean maxima in Summer, while the shortest, about 15 years, occur with annual means and Spring and Autumn seasonal minima. Table VI summarises these results according to time average and parameter. Variations with time of year, with station and with forecast period also occur but these variations are not as consistent (in the case of time of year) or not as great (in the case of station and forecast period) to warrant further classification. For convenience single values are given but a minimum averaging period about one third shorter than that specified is generally acceptable.

References

COURT, A - 1967-68. Climatic normals as predictors. Parts 1-5, Sci. Reps 105 Contract AF19(628)-5716, Project 8624. Bedford, Mass. (A.F.Cambridge Res. Lab)

CRADDOCK, J.M. and GRIMMER, M. - 1960. Estimation of mean annual temperature from temperatures of previous years. Weather, Vol 15, No. 10, pp 340-348.

CRADDOCK, J.M. - 1967. An experiment in the analyses and prediction of time series. The Statistician, Vol 17, No. 3 pp 257-268.

CRADDOCK, J.M. - 1976. Climatic estimation by exponential smoothing (unpublished) - paper discussed at a workshop of Climatic Research Unit, University of East Anglia.

DIXON, W.J. - 1974. Biomedical Computer Programs (BMD). Manual date 1974. Program used was BMDØ2T, revision date March 1971.

DIXON, W.J. - 1975. Biomedical Computer Programs (BMDP). Manual date 1975. Programs used were BMDP1R and BMDP2R, both with revision date February 1976. The programs were developed at the Health Services Computing Facility, UCLA. The Health Services Computing Facility is sponsored by N.I.H. Special Resources Grant RR-3.

DYER, T.G.J. - 1976. An analysis of Manley's Central England temperatures, I. Q.J.R. Met. S., Vol 102, No. 434, pp 871-888.

ENGER, I. - 1959. Optimum length of record for climatological estimates of temperatures. Jour. Geophys. Res., Vol 64, No. 7, pp 779-787.

LAMB, H.H. - 1977. Climate: present, past and future. Vol 2. Climatic history and the future. London (Methuen and Co. Ltd).

MANLEY, G.T. - 1941. The Durham Meteorological Record, 1847-1940. Q.J.R. Met. S., Vol 67, No. 292, pp 363-380.

MANLEY, G.T. - 1974. Central England Temperatures: monthly means 1659-1973. Q.J.R. Met. S., Vol 100, No. 425, pp 389-405.

WORLD METEOROLOGICAL ORGANISATION - 1967. A note on climatological normals. Tech Note. No. 84. WMO - No. 208. TP.108.

WORLD METEOROLOGICAL ORGANISATION - 1976. Technical regulations, No. 49, part [A.2.4] 4.2.5.

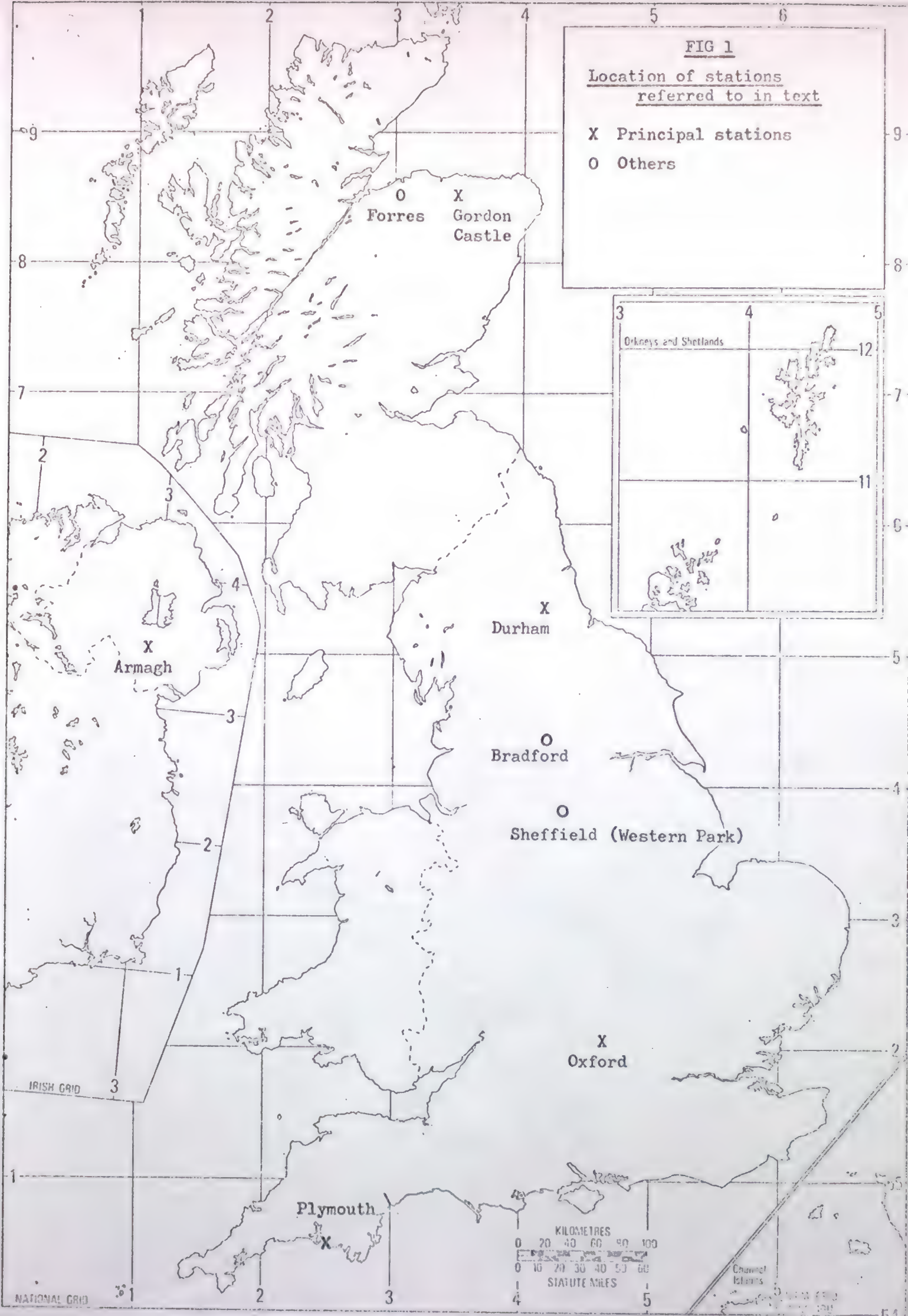


FIG 1
Location of stations referred to in text
X Principal stations
O Others
O Forres
X Gordon Castle
X Armagh
X Durham
O Bradford
O Sheffield (Western Park)
X Oxford
Plymouth
X
Orkneys and Shetlands
IRISH GRID
NATIONAL GRID
KILOMETRES
0 20 40 60 80 100
0 10 20 30 40 50 60
STATUTE MILES
Channel Islands

Fig 2A

Cumulative differences from the 1882-1976 mean for selected monthly maxima at Oxford

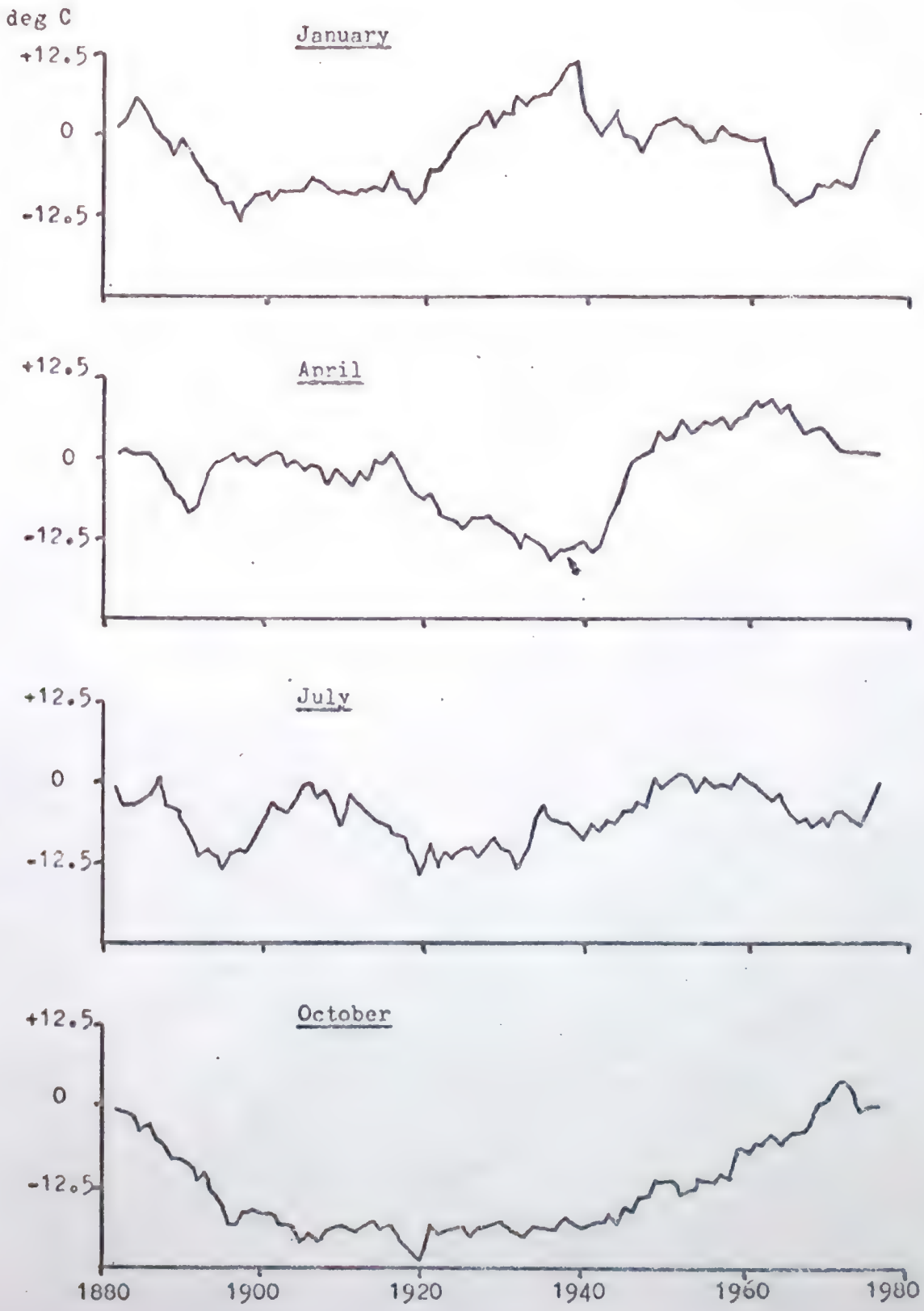


Fig 2B

Cumulative differences from 1882-1976 means

for selected monthly minima at Oxford

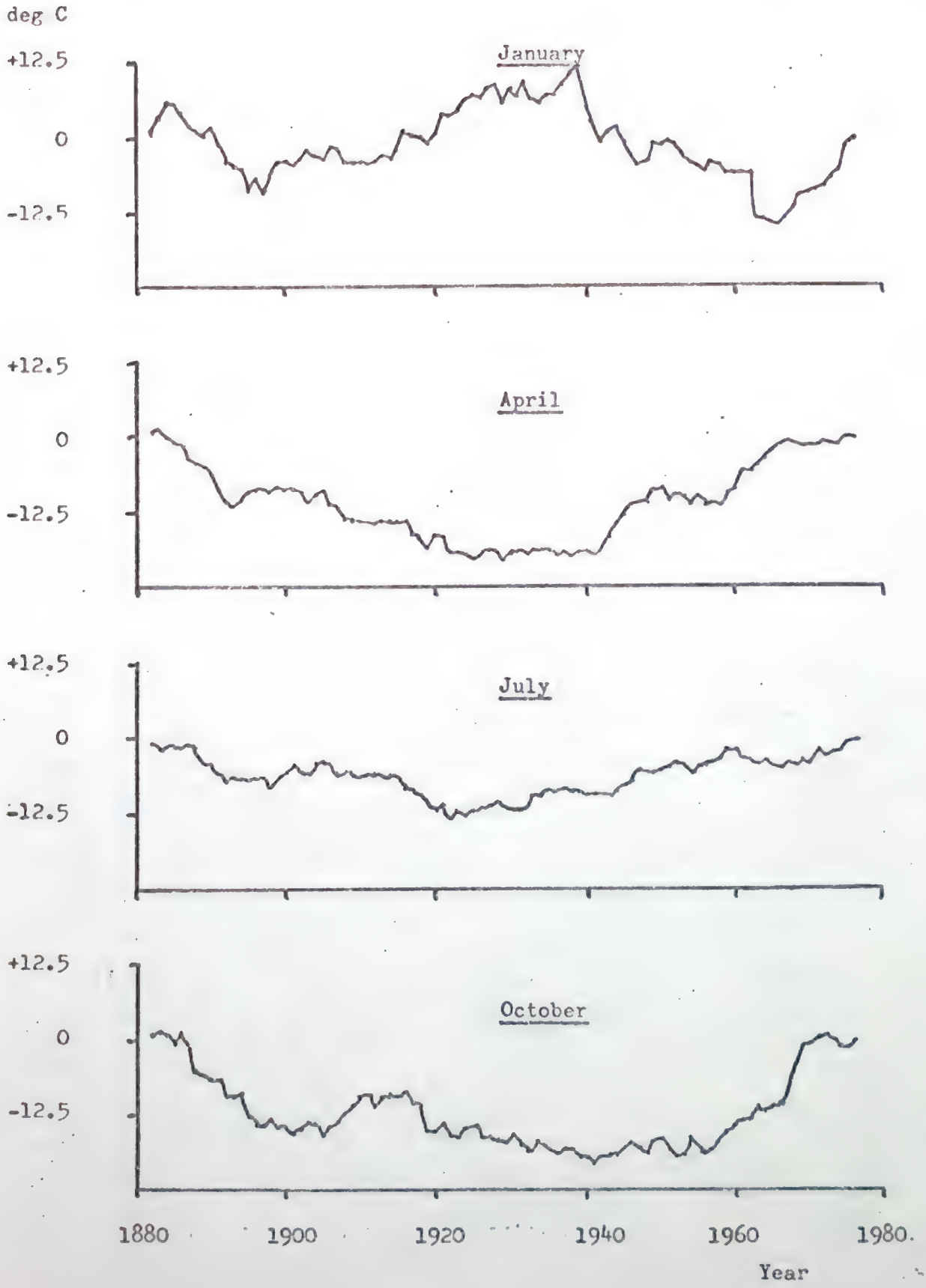


Fig 5

Oxford, April Maximum Temperatures

Forecast period mean of 10 years
minus averaging period mean of
30 years, from 1911 to 1966

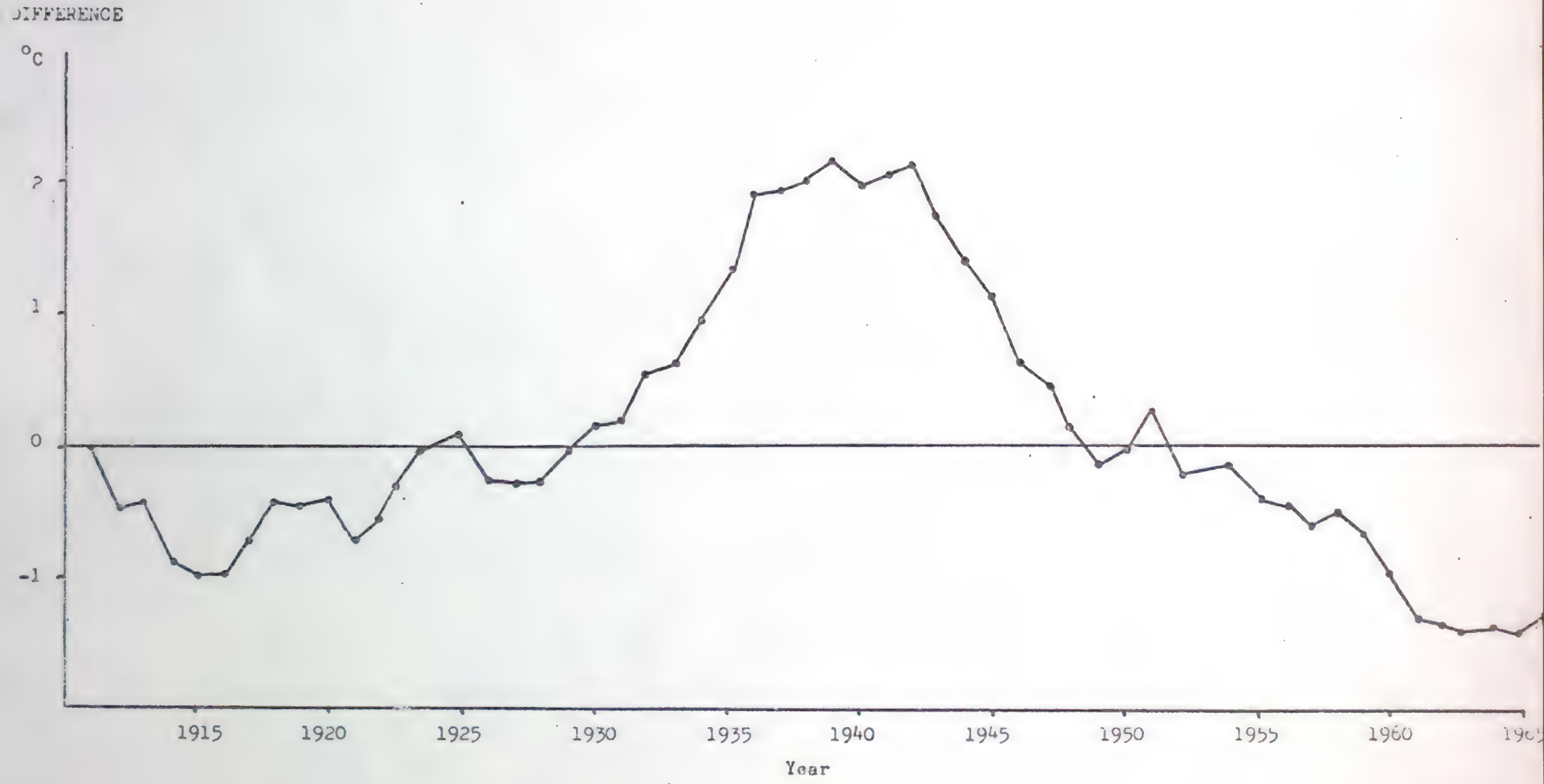


Fig 4

Value of index for Oxford Summer and Winter Maxima

Forecast period 10 years

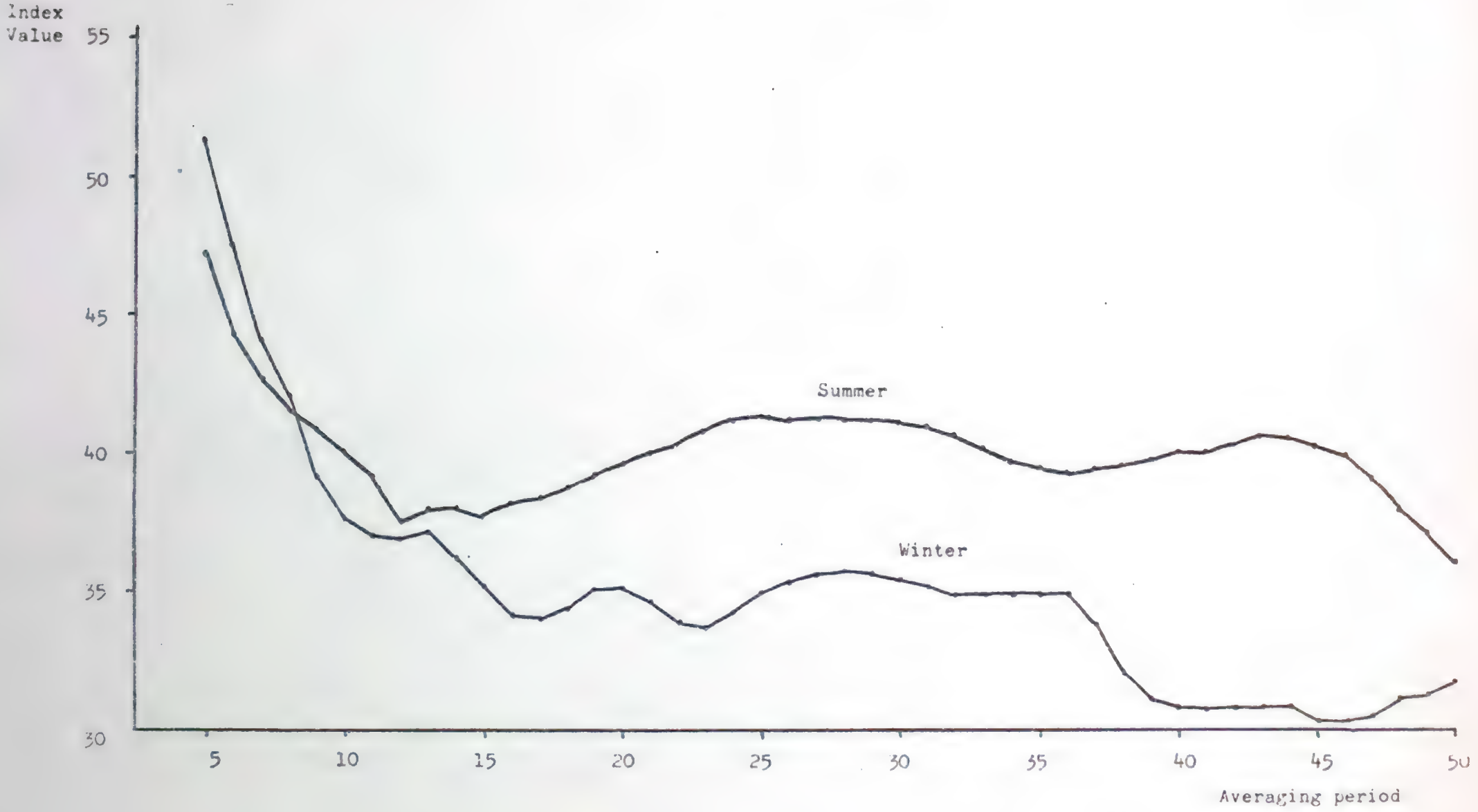


Fig 5

Comparison of index value for Sheffield and Bradford 1908-1976

Forecast Period 10 Years

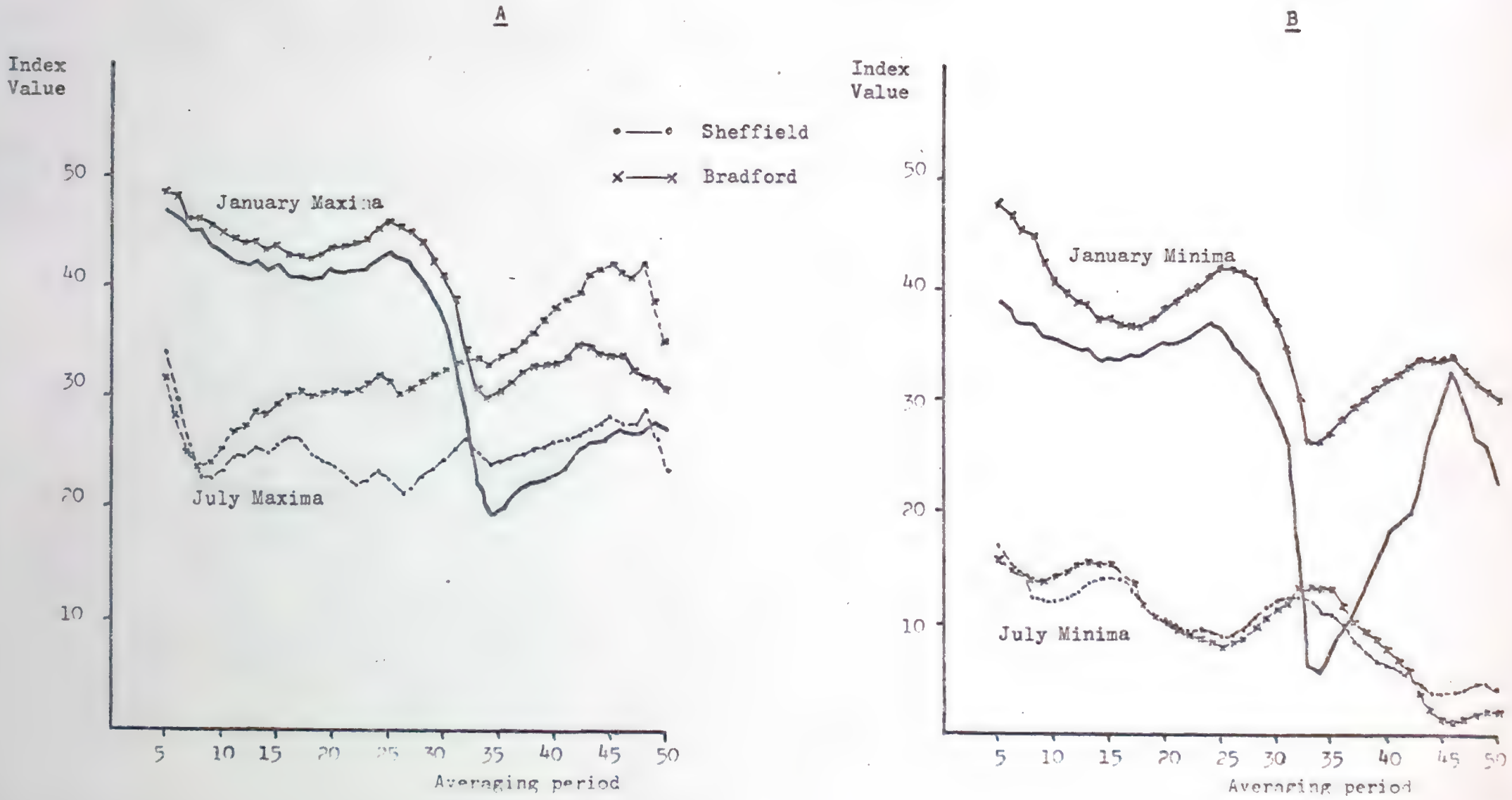


Fig 6A

Index values for selected monthly maxima at Oxford

Forecast Period 10 years

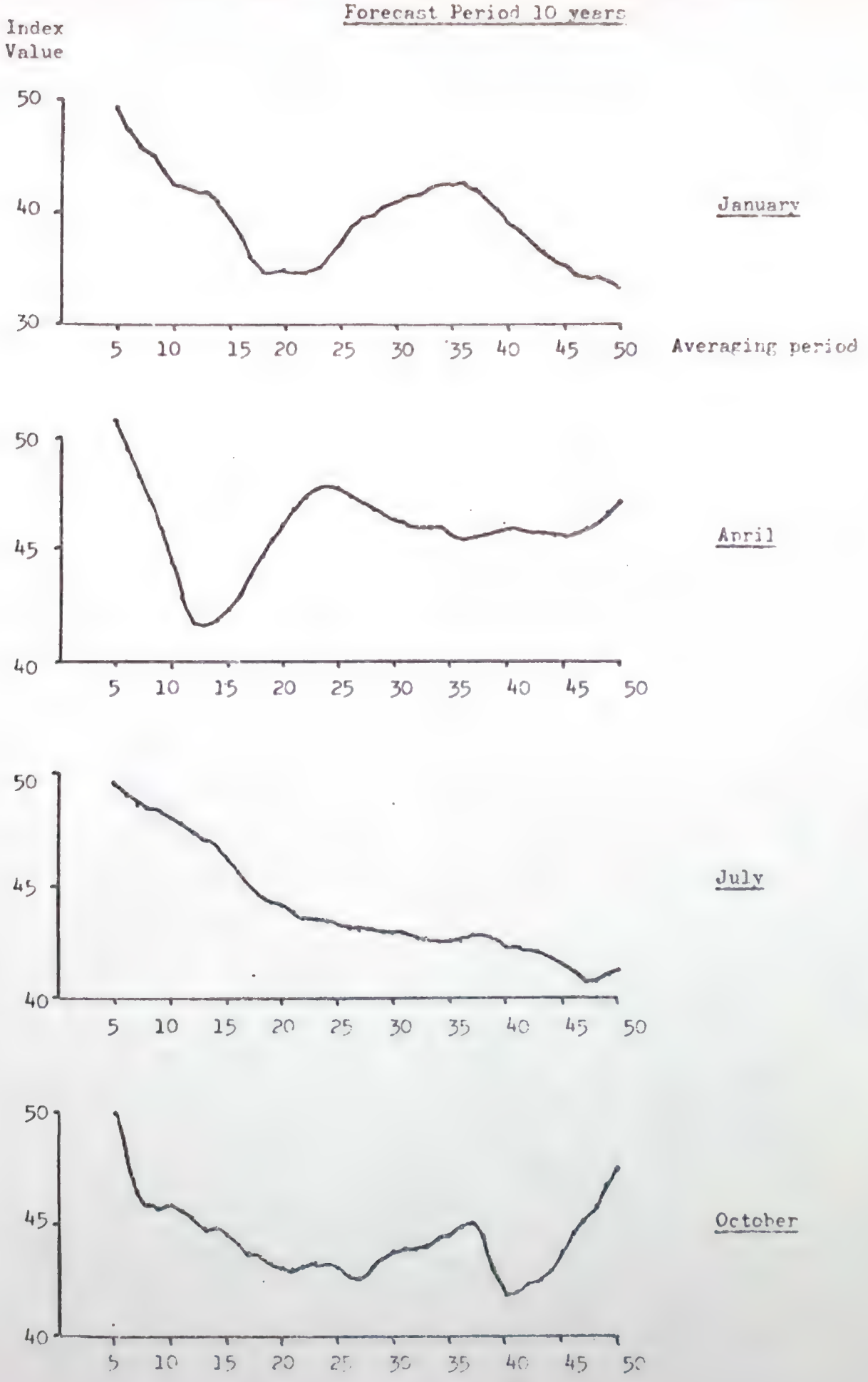


Fig 6B

Index values for selected monthly minima at Oxford

Forecast period 10 years

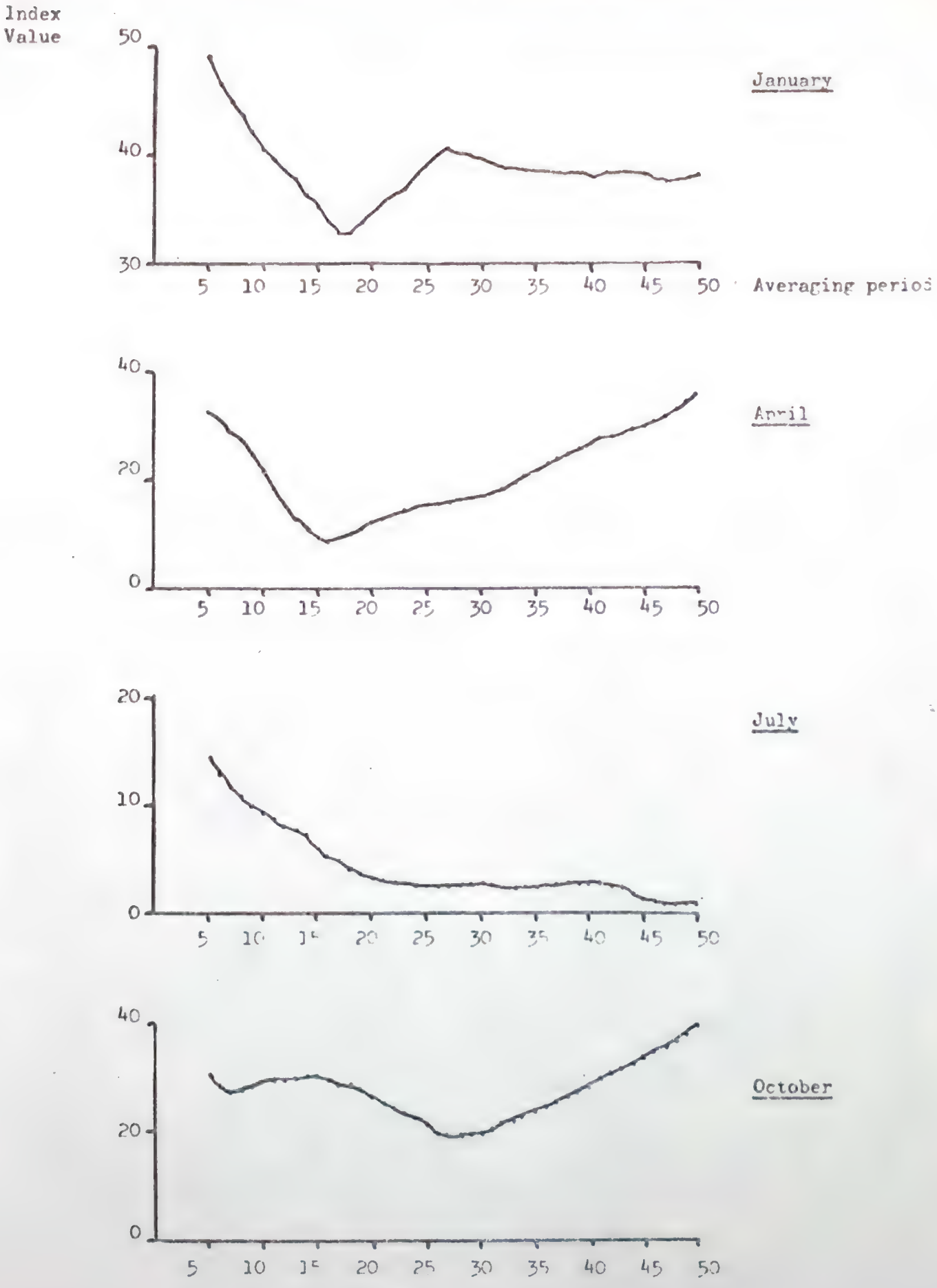


Fig. 7

1882-1976 Oxford Monthly Means, Forecast Period 10 Years

Difference between minimum index value and index value for given averaging period

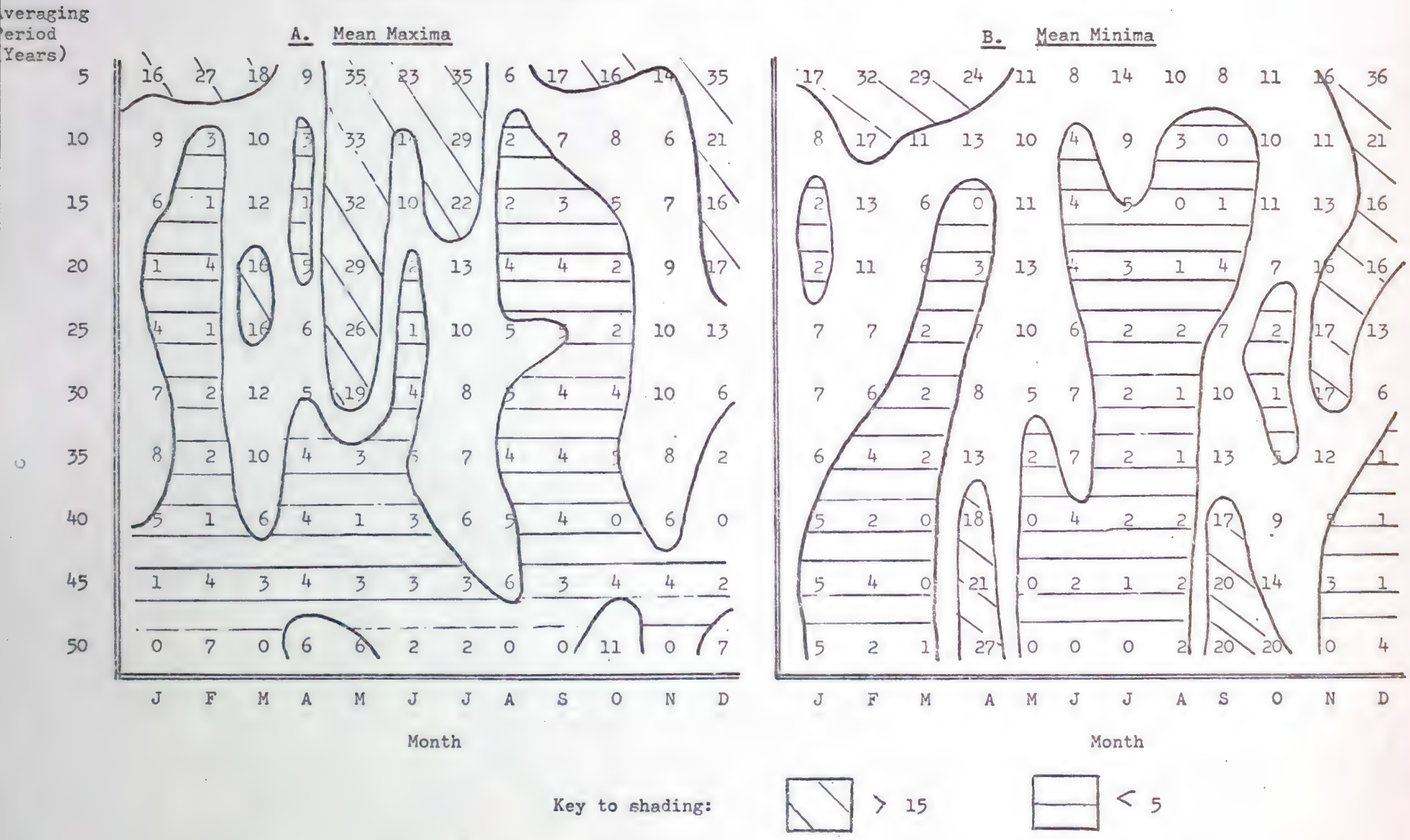


Fig 8A

Cumulative Differences from the 1882-1976

Mean for April Mean Monthly Maximum Temps

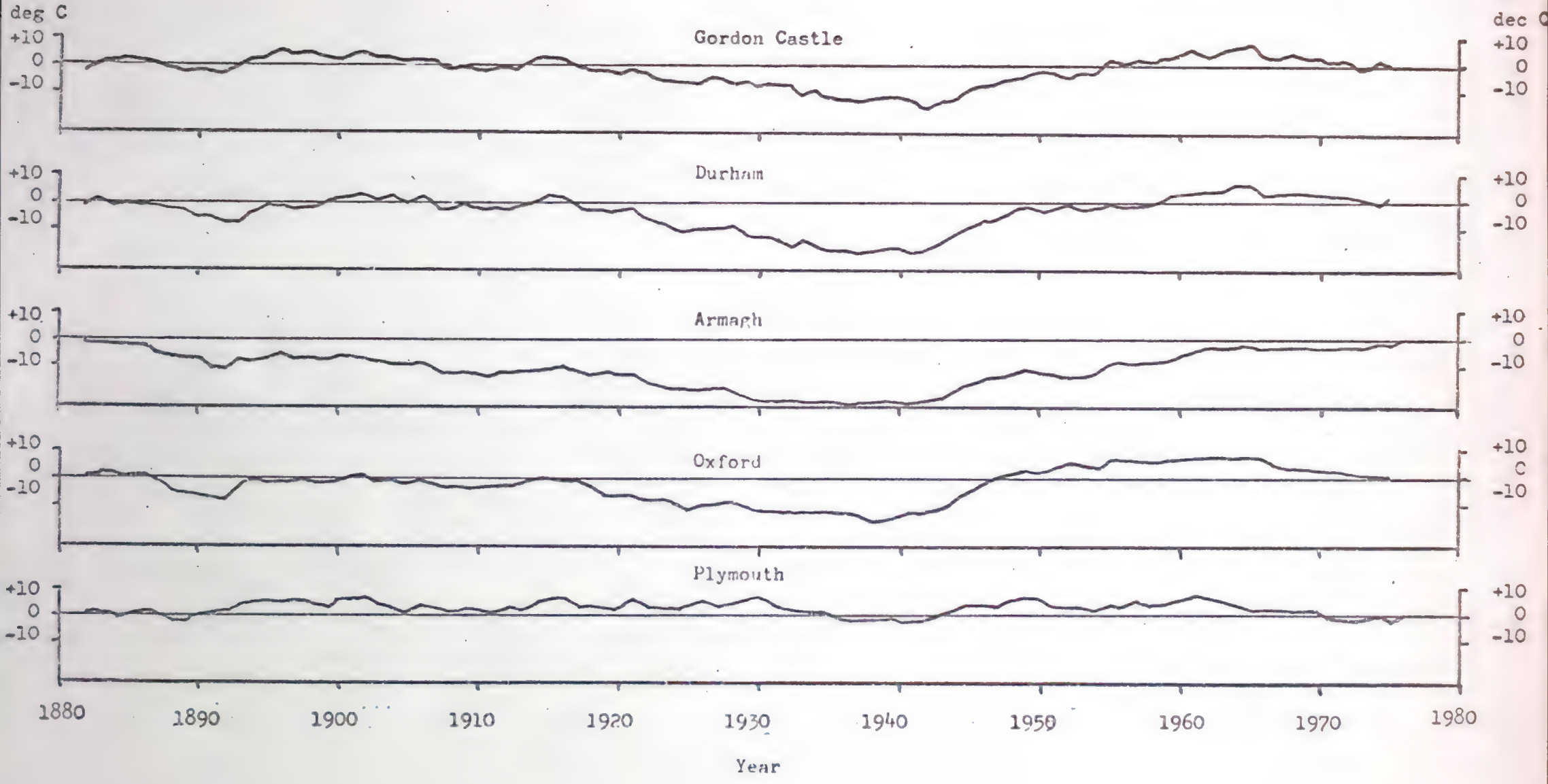


Fig 8B

Cumulative Differences from the 1882-1976 Mean for

October Mean Monthly Maximum Temperatures

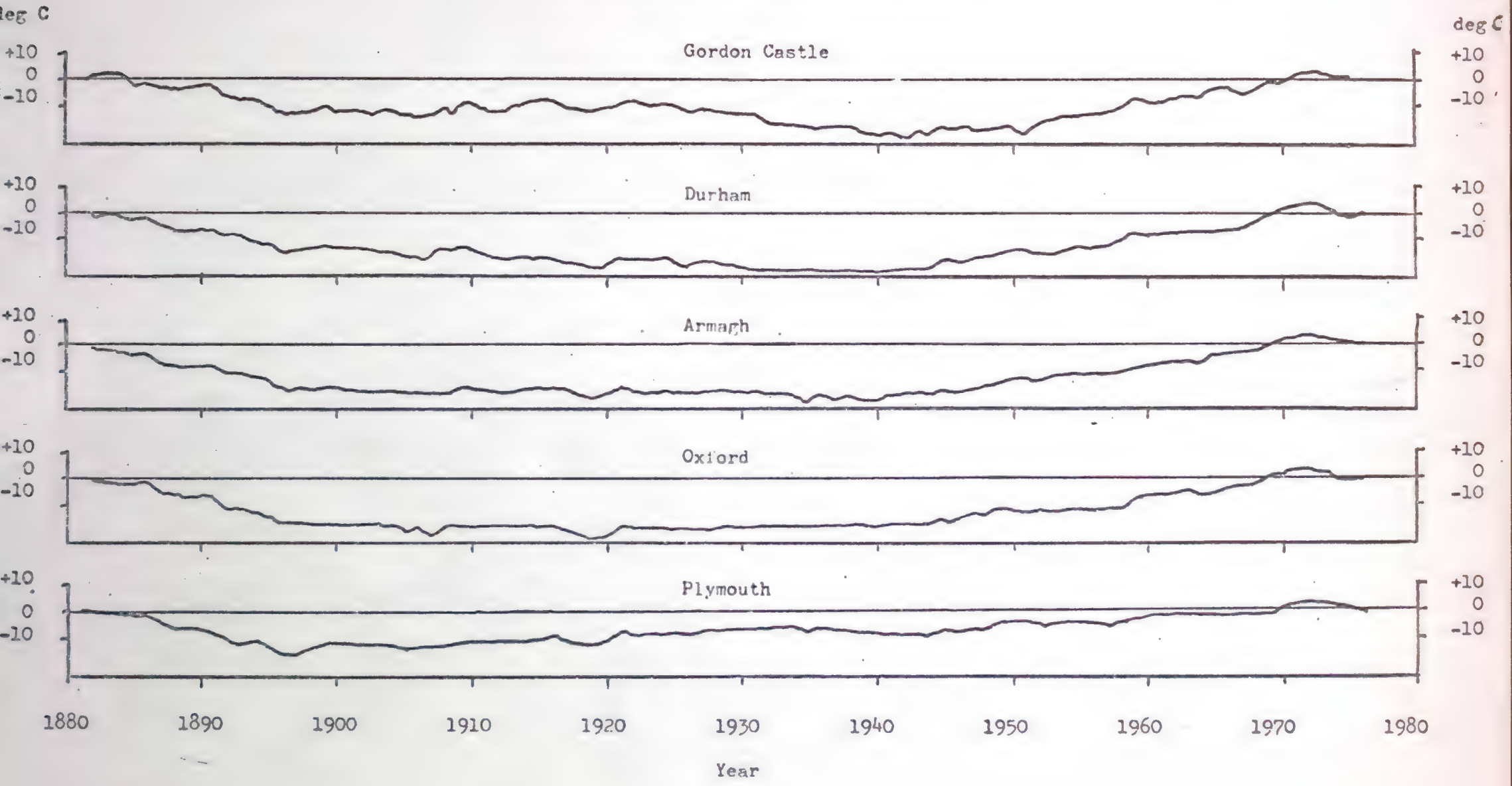
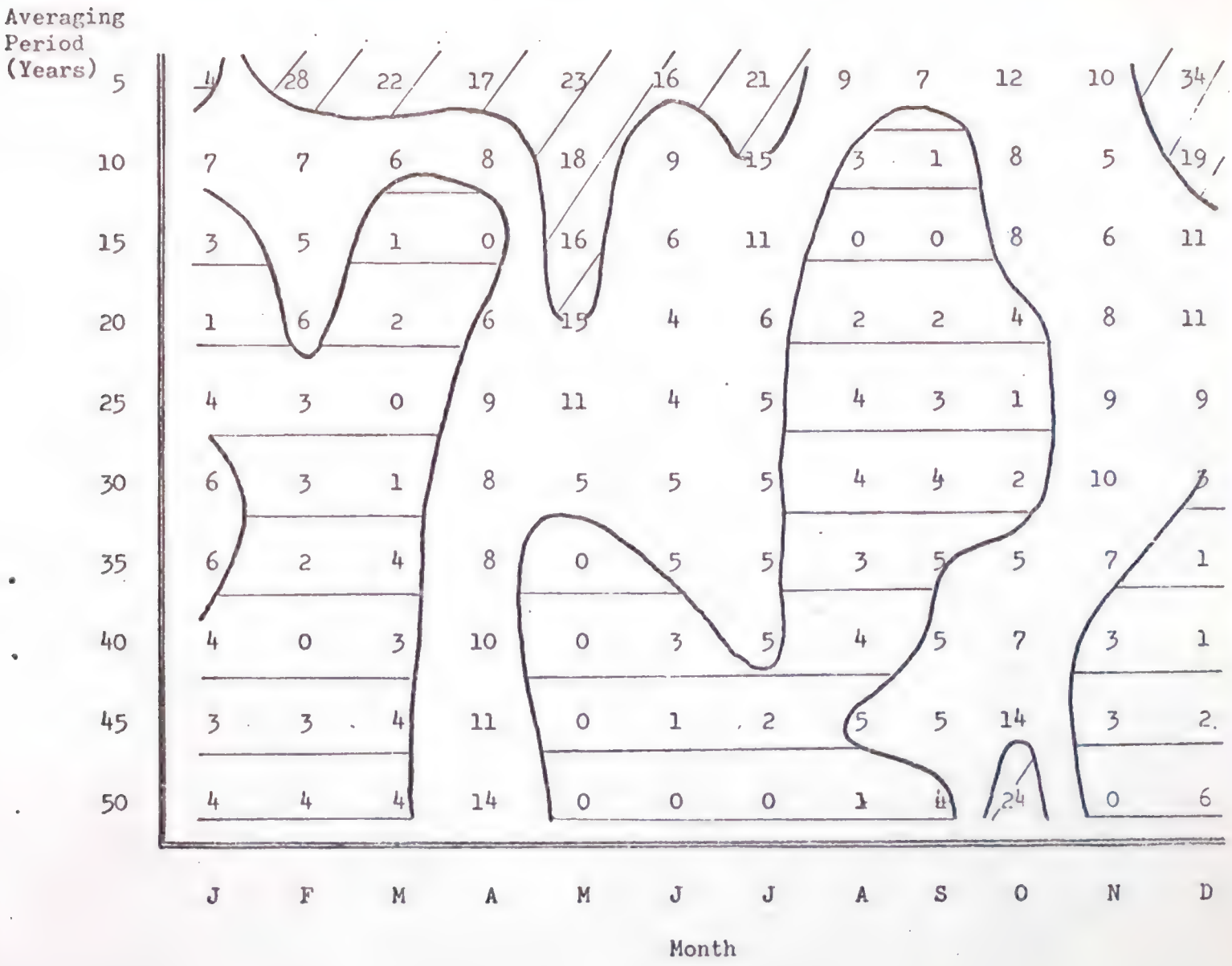


Fig 9A

1882-1976 Central England Temperatures

Monthly Averages, Forecast Period 10 Years

Difference between minimum index value and index value for given averaging period



Key to shading:

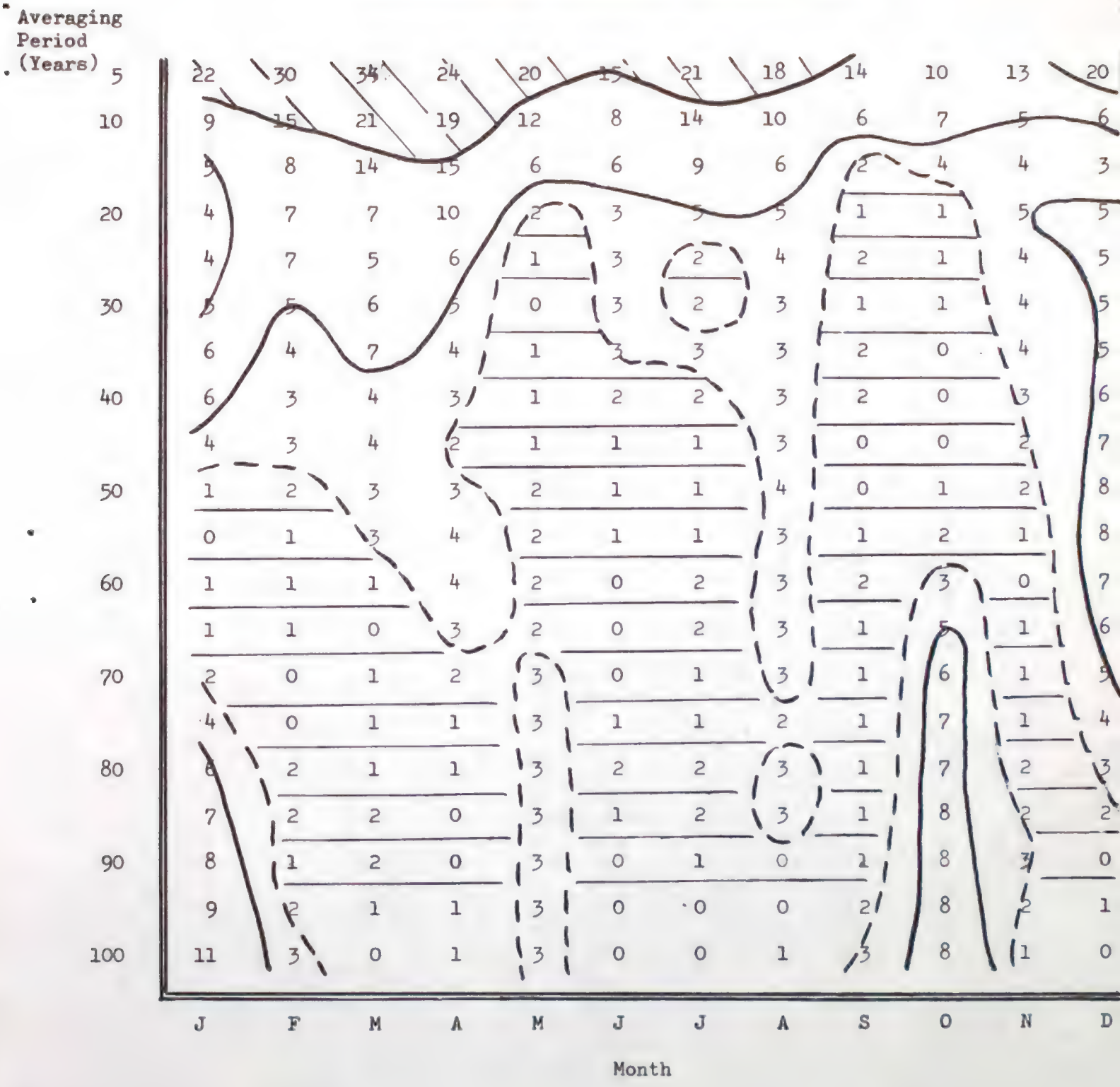
> 15

< 5

Fig 9B

1723-1976 Central England Temperatures

Monthly Averages, Forecast Period 10 Years



Difference between minimum index value and index value

for specified averaging periods

Key to shading: > 15 —— 5 < 2½

Fig 10A.

Index Value for Central England Mean January Temperatures

Over Three Different Periods. Forecast Period 10 Years

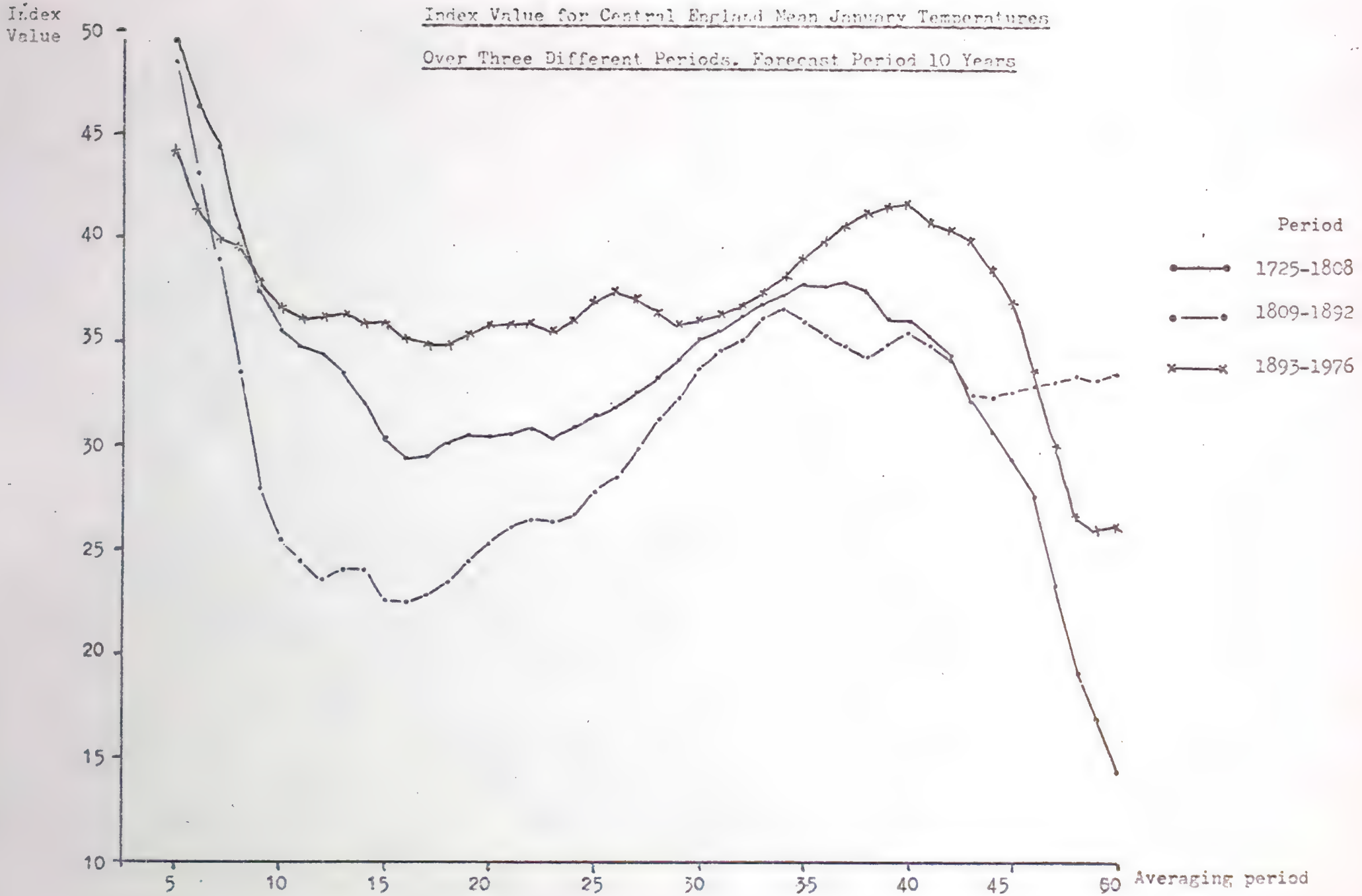


Fig. 10B

Index Value for Central England Mean July Temperatures

Over Three Different Periods. Forecast Period 10 Years

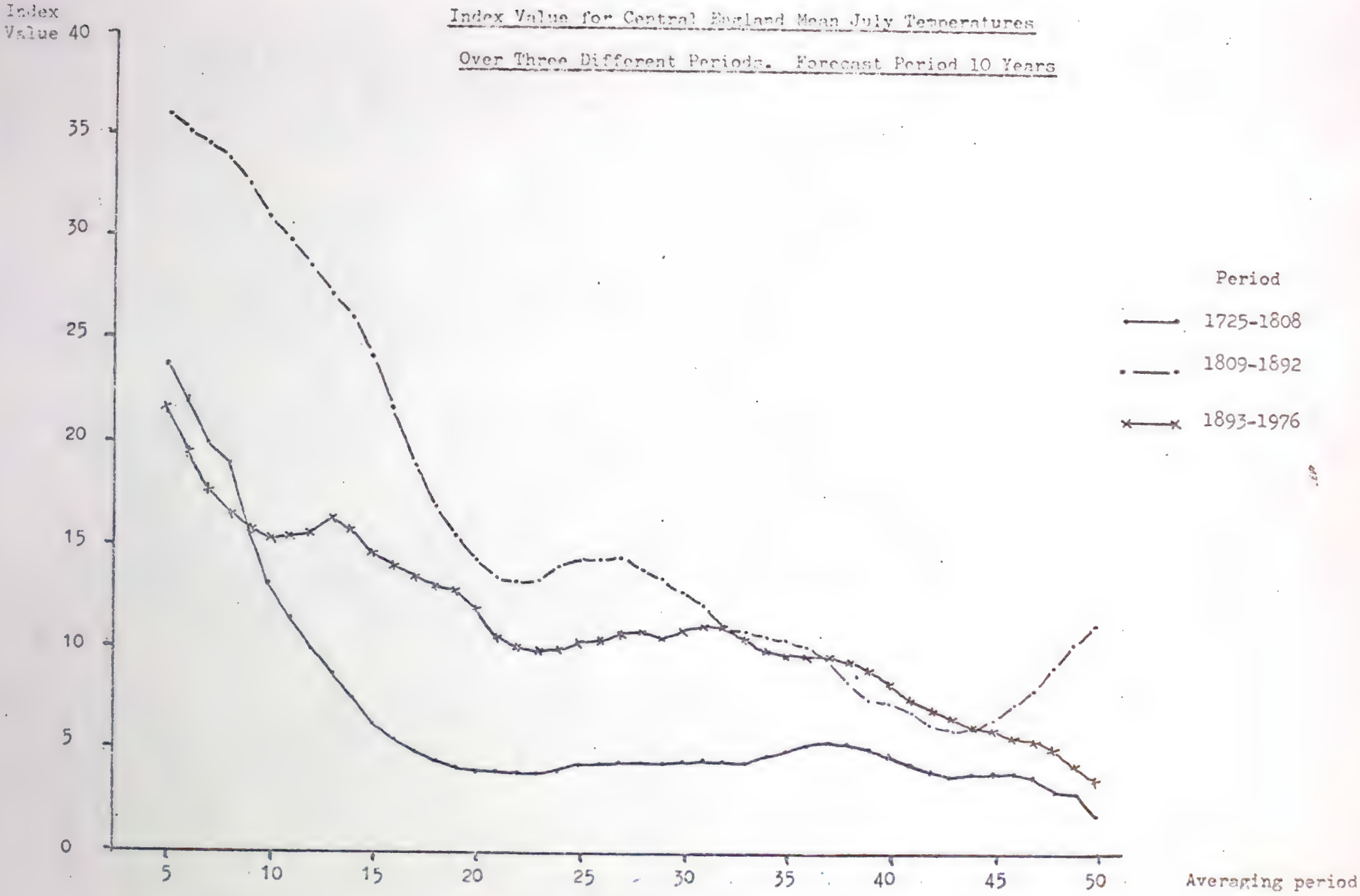
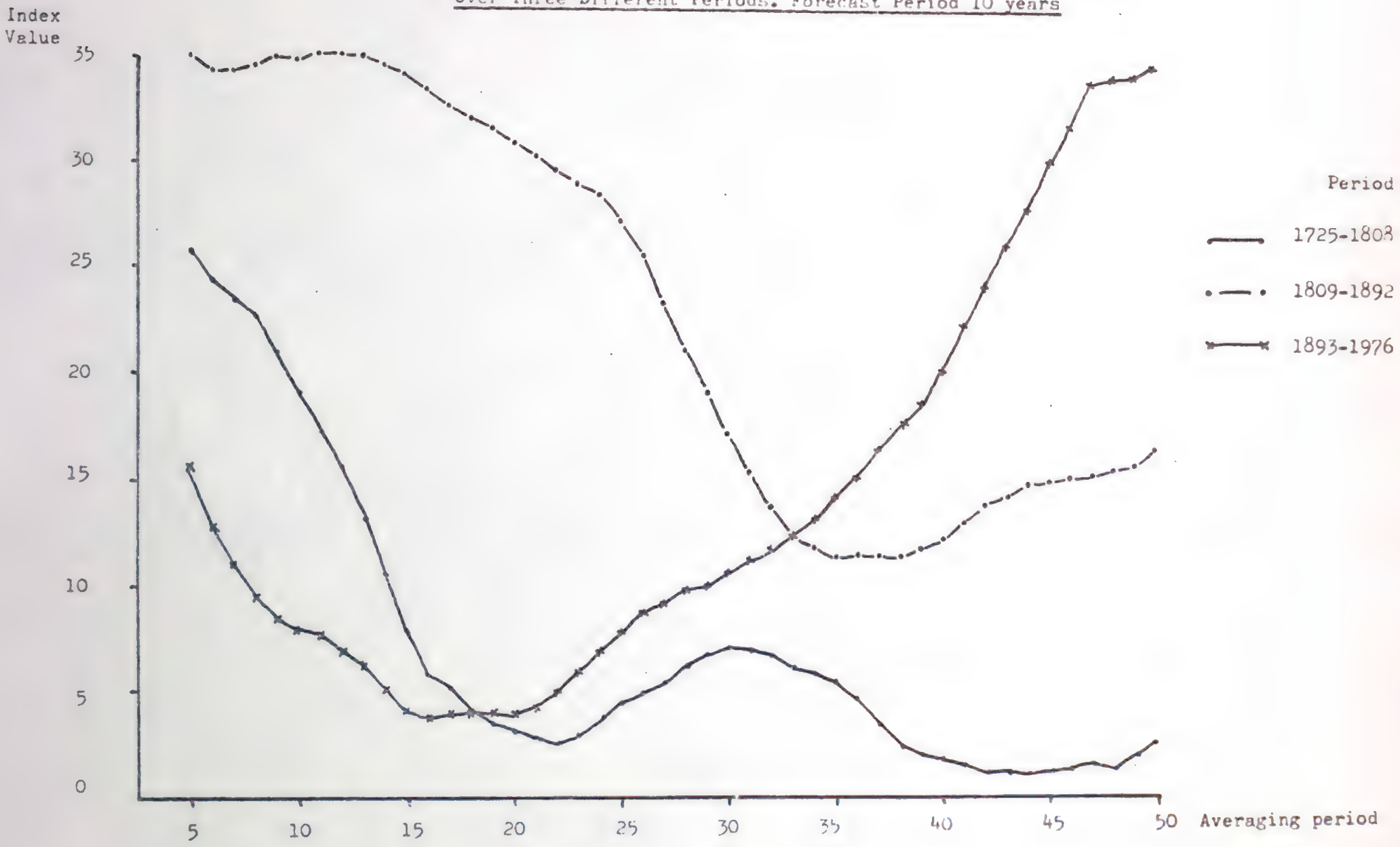


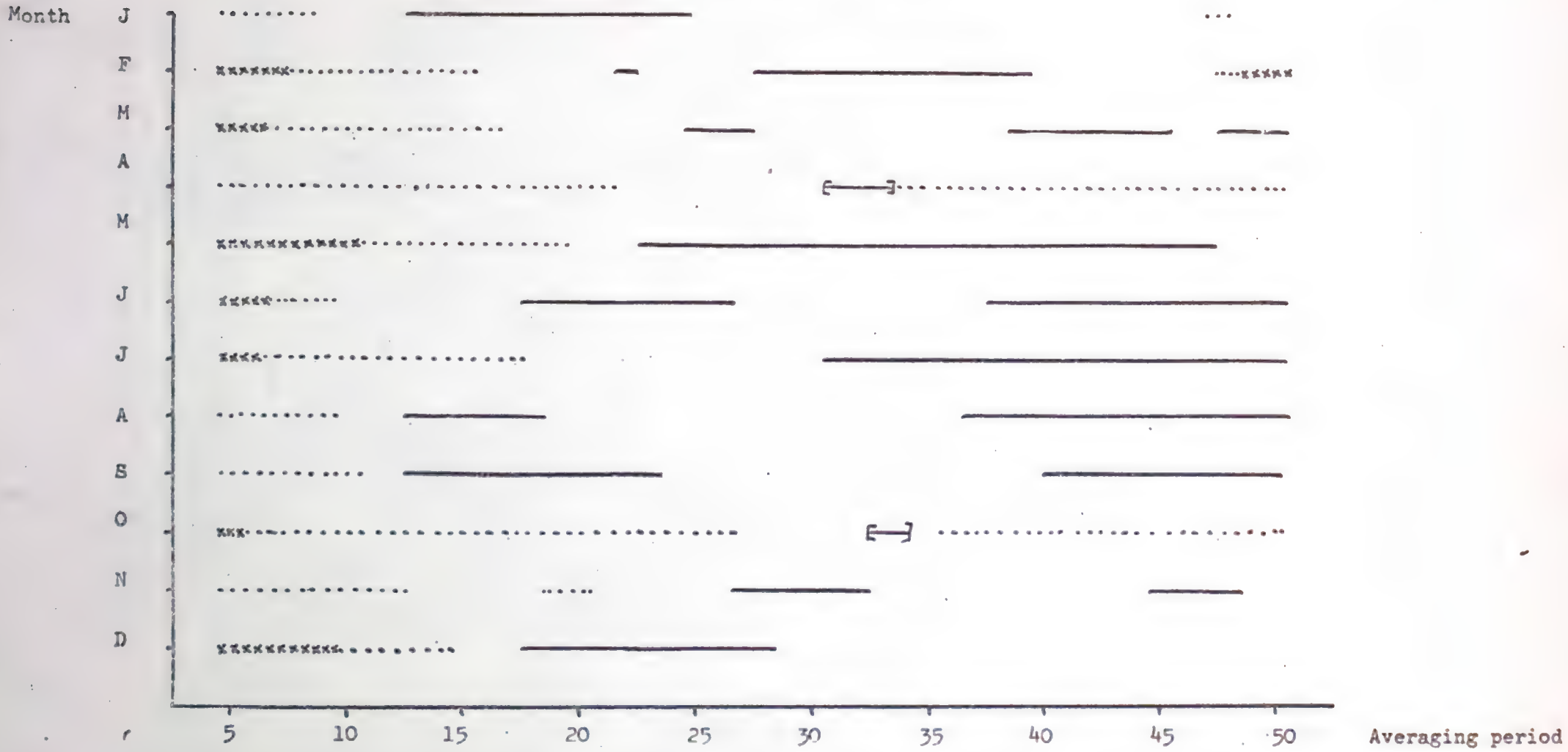
Fig. 10c

Index Value for Central England Mean October Temperatures

Over Three Different Periods. Forecast Period 10 years



Averaging periods satisfying given criteria for index values of monthly Central England temperatures over 3 periods. Forecast period 10 years



1. ——— differences within 5 of the minimum index value for all 3 periods
2. ····· one or two differences from the minimum greater than 10
3. ××××× all three differences from the minimum greater than 10

⟵⟶ Averaging periods giving most accurate results over the 3 periods (criterion 1 never satisfied)

TABLE I

Data used for determination of optimum averaging periods

TIME AVERAGE	PERIOD	STATION/AREA	PARAMETER
10 days	1882-1976	Oxford	Maxima & Minima
Month	1723-1976	Central England	Mean
	1882-1976	Principal Stations	Maxima & Minima
		UK	Maxima & Minima
		Central England	Mean
	1908-1976	Sheffield	Maxima & Minima
		Bradford	Maxima & Minima
Season	1882-1976	Principal Stations	Maxima & Minima
		UK	Maxima & Minima
Year	1882-1976	Principal Stations	Mean
		UK	Mean

For explanation of terms see text

TABLE II

STANDARD DEVIATIONS OF MEAN TEMPERATURES 1882-1976

(i) Oxford 10-day means

10-Day Means	J A N			F E B			M A R			A P R			M A Y			J U N		
Maxima	2.73	2.76	2.65	2.78	2.87	2.87	2.63	2.21	2.73	2.52	2.50	1.97	2.03	2.31	2.31	2.44	2.27	2.26
Minima	2.62	2.80	2.78	2.80	2.86	2.73	2.50	2.01	2.10	1.78	1.83	1.63	1.66	1.75	1.52	1.27	1.45	1.29

10-Day Means	J U L			A U G			S E P			O C T			N O V			D E C		
Maxima	2.57	2.58	2.29	2.35	2.40	2.29	2.57	1.87	1.93	2.08	1.73	1.70	1.57	1.92	2.12	2.17	2.60	2.62
Minima	1.31	1.17	1.22	1.25	1.36	1.33	1.62	1.65	1.94	2.09	2.15	2.26	1.88	2.18	2.40	2.40	2.50	2.65

TABLE II cont.

STANDARD DEVIATIONS OF MEAN TEMPERATURES 1882-1976

(ii) Monthly Means

Month \ Station	GOR	DUR	ARM	OXF	PLY
JAN	1.61	1.67	1.42	1.90	1.46
FEB	1.89	1.91	1.57	2.21	1.66
MAR	1.99	1.97	1.48	1.91	1.26
APR	1.45	1.50	1.25	1.51	1.01
MAY	1.59	1.53	1.15	1.48	1.22
JUN	1.37	1.53	1.34	1.53	1.40
JUL	1.35	1.53	1.15	1.88	1.43
AUG	1.43	1.54	1.34	1.78	1.44
SEP	1.34	1.36	1.15	1.59	1.24
OCT	1.45	1.30	1.17	1.35	1.13
NOV	1.32	1.17	1.11	1.27	1.03
DEC	1.43	1.58	1.38	1.80	1.32

MAXIMA

Month \ Station	GOR	DUR	ARM	OXF	PLY
JAN	1.48	1.44	1.52	1.86	1.71
FEB	1.72	1.62	1.68	2.02	1.86
MAR	1.48	1.45	1.52	1.45	1.42
APR	1.09	1.10	1.17	1.14	1.08
MAY	1.11	1.00	0.99	0.97	0.86
JUN	0.87	0.85	0.88	0.85	0.82
JUL	1.04	0.89	0.88	0.83	0.80
AUG	0.96	0.88	0.85	0.87	0.91
SEP	1.10	1.07	1.08	1.05	1.09
OCT	1.18	1.32	1.40	1.51	1.45
NOV	1.22	1.31	1.36	1.43	1.49
DEC	1.41	1.43	1.40	1.80	1.63

MINIMA

(iii) Seasonal Means

Season \ Station	GOR	DUR	ARM	OXF	PLY
WIN	1.05	1.14	0.95	1.40	1.03
SPR	1.06	1.05	0.87	1.06	0.81
SUM	0.98	1.17	0.94	1.33	1.10
AUT	0.93	0.91	0.83	0.99	0.82

Season \ Station	GOR	DUR	ARM	OXF	PLY
WIN	0.99	1.03	1.00	1.39	1.23
SPR	0.84	0.79	0.79	0.78	0.78
SUM	0.74	0.62	0.60	0.57	0.59
AUT	0.78	0.83	0.89	0.88	0.97

(iv) Annual Mean

GOR	DUR	ARM	OXF	PLY
0.49	0.54	0.47	0.59	0.47

TABLE III

Percentage probability of differences between five 19-year means occuring by chance

Month \ Station	OXF	ARM
JAN	6	15
FEB	81	91
MAR	10	2*
APR	1*	0.3*
MAY	40	7
JUN	33	12
JUL	77	48
AUG	78	16
SEP	76	33
OCT	0.3*	0.01*
NOV	33	17
DEC	54	30

MAXIMA

Month \ Station	OXF	ARM
JAN	23	17
FEB	77	73
MAR	35	6
APR	0.3*	1*
MAY	2*	35
JUN	3*	24
JUL	9	4*
AUG	9	40
SEP	0.7*	10
OCT	2*	0.01*
NOV	23	27
DEC	63	18

MINIMA

* denotes percentage probabilities less than 5%

LP

TABLE IV

VALUE OF INDEX-OXFORD 10-DAY MEANS, FORECAST PERIOD 10 YEARS

MAXIMA

Averaging Period (Years)										
5	10	15	20	25	30	35	40	45	50	
59	52	49	42	39	41	43	44	43	46	J
53	46	37	33	35	37	38	40	41	38	A
50	46	47	47	45	40	39	33	33	36	N
40	26	20	16	20	21	21	18	12	10	F
46	29	30	31	25	24	23	26	26	29	E
40	31	22	23	23	27	29	25	29	30	B
47	37	29	26	22	23	27	24	23	23	M
37	29	21	17	18	19	21	20	19	19	A
53	40	38	41	44	45	45	46	44	37	R
47	27	20	24	26	20	17	18	14	13	A
58	60	62	63	63	62	61	62	63	65	P
47	36	22	20	21	16	16	14	10	12	R
29	19	11	4	3	3	3	3	3	3	M
47	44	41	37	32	22	13	14	14	14	A
39	39	41	43	44	40	35	39	45	47	Y
39	26	18	9	7	10	10	7	7	7	J
42	35	28	14	12	12	8	5	3	3	U
36	33	38	42	44	41	39	35	33	31	N
47	33	34	35	35	33	30	30	28	20	J
59	50	45	25	16	23	31	25	19	18	U
41	38	36	35	34	33	31	29	30	33	L
37	31	32	32	32	32	32	31	33	28	A
47	35	25	24	26	23	20	21	23	22	U
42	34	31	34	35	36	37	38	36	26	G
34	20	16	12	14	14	14	14	15	11	S
32	23	24	28	27	27	27	26	21	14	E
26	17	11	10	11	11	9	7	3	1	P
33	23	18	16	17	21	19	9	12	19	O
19	13	15	15	12	10	13	15	21	23	C
22	7	5	3	3	3	5	6	9	11	T
24	15	13	14	14	14	13	9	9	8	N
32	18	19	19	21	19	12	8	7	4	O
32	16	15	14	13	14	17	20	17	13	V
30	17	14	15	10	5	3	2	3	5	D
42	23	25	27	21	19	17	15	9	11	E
54	45	40	40	42	40	34	28	29	29	C

MINIMA

Averaging Period (Years)										
5	10	15	20	25	30	35	40	45	50	
55	48	45	40	36	32	31	33	34	37	J
58	49	37	35	40	39	37	41	43	43	A
53	49	48	50	49	47	47	46	46	47	N
43	31	22	18	21	21	20	19	17	18	F
51	40	38	38	32	27	23	22	18	12	E
49	36	29	29	30	31	31	31	32	29	B
45	35	32	35	34	34	35	34	35	33	M
36	28	21	16	15	17	16	15	10	11	A
34	16	14	14	14	19	22	24	25	21	R
29	19	11	14	16	16	19	22	20	21	A
30	18	13	13	14	17	20	24	29	36	P
29	20	9	9	11	11	13	16	19	23	R
22	20	23	25	25	25	25	26	26	28	M
30	24	16	9	7	4	3	3	3	3	A
18	15	14	14	11	7	5	4	5	6	Y
12	5	3	3	3	3	2	2	1	1	J
13	6	6	6	5	6	8	11	12	9	U
22	18	18	19	22	24	22	17	10	9	N
22	12	13	13	13	13	12	11	10	7	J
6	2	0	0	0	0	0	0	0	0	U
20	17	12	5	3	3	3	3	1	2	L
13	8	5	5	6	6	7	8	10	6	A
21	7	1	0	0	0	0	0	0	0	U
22	9	3	7	7	3	5	7	7	10	G
21	9	6	5	5	3	4	4	2	2	S
31	20	17	18	20	21	24	28	27	20	E
23	10	12	14	16	17	19	21	20	21	P
30	23	22	16	13	15	15	16	20	24	O
44	41	38	34	24	12	9	9	16	20	C
35	20	23	25	28	31	34	37	40	44	T
30	23	19	19	21	21	19	11	9	4	N
39	26	28	30	32	33	24	18	16	13	O
37	19	14	15	14	13	14	15	9	9	V
33	20	16	16	12	6	2	3	4	6	D
42	23	25	25	15	11	8	6	1	2	E
53	47	41	39	40	38	35	35	34	34	C

TABLES V(a) to V(o)

Abbreviations

GOR : Gordon Castle

DUR : Durham

ARM : Armagh

OXF : Oxford

PLY : Plymouth

UK : A temperature series corresponding to the mean of temperatures over the above 5 stations

The figures at the head of each column of the tables are averaging periods in years.

TABLE V (a) - VALUE OF INDEX - JANUARY

MEAN MAXIMA

Forecast Period 3 Years

Averaging Period									
5	10	15	20	25	30	35	40	45	50
52	47	45	44	44	46	47	48	47	48
53	50	48	47	47	49	50	50	51	51
47	43	41	41	39	42	44	42	39	39
60	58	58	57	56	59	61	60	60	60
49	48	47	46	44	47	50	49	47	48
49	47	45	45	43	46	48	47	46	47

	Averaging Period									
	5	10	15	20	25	30	35	40	45	50
GOR	50	47	45	45	46	48	50	50	49	50
DUR	50	49	47	45	44	47	47	48	49	50
ARM	47	46	45	44	43	46	49	49	48	49
OXF	58	57	55	55	55	58	59	58	59	60
PLY	53	52	51	48	49	51	51	51	51	52
UK	47	47	44	43	43	46	47	47	47	48

Forecast Period 5 Years

5	10	15	20	25	30	35	40	45	50
47	39	36	35	34	37	38	39	38	39
44	38	34	33	33	35	37	37	37	37
38	32	29	28	26	30	32	29	23	22
53	50	49	46	46	49	51	50	48	48
45	41	39	35	34	38	41	39	36	36
42	37	34	32	31	35	37	37	34	34

	5	10	15	20	25	30	35	40	45	50
GOR	40	42	39	39	41	43	44	45	43	44
DUR	46	42	37	34	35	37	37	39	40	43
ARM	41	38	36	33	33	37	39	39	37	38
OXF	52	49	46	44	47	49	49	49	49	50
PLY	46	42	39	34	35	39	39	38	38	38
UK	42	38	34	31	33	37	37	37	37	37

Forecast Period 10 Years

5	10	15	20	25	30	35	40	45	50
40	31	26	23	24	25	27	27	26	30
38	28	24	21	22	24	25	24	22	22
33	34	22	18	19	22	22	16	10	10
49	43	39	35	37	41	42	39	35	34
39	31	28	22	24	29	31	26	24	25
35	28	25	21	23	26	27	24	21	21

	5	10	15	20	25	30	35	40	45	50
GOR	42	32	27	29	32	32	34	33	32	35
DUR	40	29	21	17	21	21	21	23	23	21
ARM	39	32	28	24	26	30	31	31	31	35
OXF	49	41	35	35	39	40	38	38	38	38
PLY	42	35	28	23	27	30	29	27	26	18
UK	37	28	22	20	24	25	26	25	24	24

Forecast Period 20 Years

5	10	15	20	25	30	35	40	45	50
37	33	20	16	16	17	17	17	17	18
34	21	17	15	15	15	13	8	6	5
30	19	16	16	15	14	10	2	0	0
45	37	34	33	35	35	32	23	19	17
31	23	20	19	22	23	21	14	10	10
32	23	20	19	20	20	17	10	4	3

	5	10	15	20	25	30	35	40	45	50
GOR	32	22	21	21	22	22	22	22	23	25
DUR	31	17	12	10	10	10	8	3	2	1
ARM	31	24	23	23	24	26	27	26	26	25
OXF	42	35	32	31	32	31	29	29	28	23
PLY	37	30	26	24	25	27	24	14	9	5
UK	29	21	19	17	19	19	17	11	7	5

MEAN MINIMA

TABLE V (b) - VALUE OF INDEX - FEBRUARY

MEAN MAXIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
55	52	49	48	47	47	47	47	49	50	GOR
60	55	51	52	51	51	51	52	54	53	DUR
49	46	42	42	41	42	43	43	44	44	ARM
64	59	54	56	55	56	56	56	57	57	OXF
56	49	45	48	47	48	49	49	48	49	PLY
55	50	45	47	46	47	47	47	48	48	UK

Forecast Period 5 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
44	39	35	33	32	29	30	31	34	34	GOR
48	39	33	34	32	31	32	33	35	34	DUR
36	32	25	26	26	25	26	25	27	27	ARM
53	43	36	41	40	39	40	39	40	40	OXF
44	35	30	34	35	35	37	36	34	33	PLY
42	33	27	30	29	27	28	28	30	30	UK

Forecast Period 10 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
37	28	22	19	15	12	13	15	17	17	GOR
38	19	14	12	7	7	6	8	10	10	DUR
30	18	13	13	12	11	11	9	12	13	ARM
44	19	17	20	17	18	19	17	21	23	OXF
37	20	18	22	22	23	24	19	21	22	PLY
33	15	13	14	11	11	10	10	12	13	UK

Forecast Period 20 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
31	23	17	16	13	10	11	12	13	11	GOR
32	14	6	5	2	1	2	3	4	4	DUR
20	11	7	7	4	2	2	2	2	2	ARM
40	21	16	18	15	13	15	14	17	17	OXF
33	22	20	23	22	20	21	20	19	17	PLY
26	14	10	11	9	6	7	7	8	7	UK

MEAN MINIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
49	47	44	45	47	48	49	49	49	51	GOR
55	52	47	49	48	48	48	49	51	51	DUR
50	48	43	43	44	44	46	43	44	45	ARM
61	57	52	53	53	53	53	53	53	53	OXF
58	53	49	50	50	51	52	51	51	53	PLY
51	47	42	44	44	44	45	44	45	46	UK

Forecast Period 5 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
38	35	34	35	37	38	40	39	39	39	GOR
45	36	32	34	32	30	30	30	33	33	DUR
37	33	28	29	30	32	34	30	30	31	ARM
52	43	38	39	38	36	36	36	36	32	OXF
48	39	34	37	37	38	40	37	36	39	PLY
37	30	26	29	28	28	30	28	28	29	UK

Forecast Period 10 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
33	31	29	31	32	34	33	32	33	33	GOR
33	17	15	14	9	7	6	7	10	9	DUR
31	21	18	19	20	23	23	17	21	21	ARM
45	30	25	23	20	19	17	15	17	14	OXF
40	24	22	23	24	25	24	18	20	20	PLY
30	18	16	17	16	16	15	12	15	15	UK

Forecast Period 20 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
33	30	31	34	34	34	33	31	30	31	GOR
29	15	11	9	5	2	3	3	4	4	DUR
28	20	18	20	18	18	18	15	16	16	ARM
40	26	19	15	11	5	4	3	3	1	OXF
37	25	23	25	24	20	20	15	13	11	PLY
25	16	16	17	14	11	12	10	9	9	UK

TABLE V (c) - VALUE OF INDEX - MARCH

Forecast Period 3 Years

MEAN MAXIMA											MEAN MINIMA										
Averaging Period											Averaging Period										
5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50	
52	48	44	44	45	46	45	45	47	46	GOR	41	35	32	34	34	34	36	37	38	41	GOR
55	51	46	48	49	49	48	48	49	49	DUR	48	41	39	40	39	39	38	38	38	41	DUR
36	33	27	29	31	33	34	36	39	40	ARM	41	38	36	36	37	40	42	43	44	47	ARM
54	51	46	46	48	47	48	46	47	48	OXF	53	43	39	40	36	36	34	31	29	28	OXF
37	29	24	23	23	23	23	23	23	23	PLY	47	36	33	32	32	32	34	35	35	39	PLY
46	41	35	36	37	38	37	37	39	39	UK	43	34	30	31	30	30	31	30	30	34	UK

Forecast Period 5 Years

5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50	
41	32	27	29	30	31	29	31	29	28	GOR	26	17	11	13	14	14	19	20	21	27	GOR
44	36	28	33	35	34	31	31	30	30	DUR	39	28	24	25	23	21	21	23	25	29	DUR
27	20	12	17	20	22	24	27	29	31	ARM	35	32	28	29	31	33	35	37	39	43	ARM
44	39	29	31	34	31	31	30	28	28	OXF	42	30	23	25	21	16	17	15	14	15	OXF
28	18	10	10	10	9	11	11	8	10	PLY	39	26	20	22	23	21	26	27	27	33	PLY
35	26	17	21	22	23	24	22	22	23	UK	32	22	15	17	16	15	17	19	19	25	UK

Forecast Period 10 Years

5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50	
33	21	19	21	22	23	24	24	23	20	GOR	16	5	3	4	5	7	11	11	16	19	GOR
40	28	27	31	31	29	28	27	27	25	DUR	28	11	9	8	5	5	5	6	9	9	DUR
23	12	10	15	17	19	23	27	30	33	ARM	31	23	18	20	22	25	28	31	35	37	ARM
33	25	27	31	31	27	25	21	18	15	OXF	29	11	6	7	2	2	2	0	1	1	OXF
20	6	3	4	3	4	6	4	4	5	PLY	27	11	8	10	10	12	17	17	20	21	PLY
29	15	12	16	16	17	20	19	19	18	UK	21	7	4	5	3	5	7	7	11	14	UK

Forecast Period 20 Years

5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50	
30	20	18	18	20	23	26	24	22	19	GOR	15	6	3	5	6	8	13	13	15	18	GOR
40	32	29	29	28	27	27	26	24	21	DUR	25	10	5	3	1	1	1	1	1	3	DUR
23	16	14	17	21	25	32	37	41	40	ARM	23	17	15	17	19	23	31	36	37	36	ARM
32	30	32	33	29	21	12	3	0	0	OXF	28	12	3	3	1	0	0	0	0	0	OXF
15	4	1	1	1	1	2	1	1	1	PLY	26	12	7	11	12	14	20	20	20	21	PLY
27	17	13	14	16	17	21	20	19	15	UK	18	7	2	3	2	1	4	4	6	10	UK

TABLE V (d) - VALUE OF INDEX - APRIL

MEAN MAXIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
52	49	45	45	48	49	46	47	47	46	GOR
50	51	47	48	52	53	52	52	51	49	DUR
43	42	36	35	39	41	40	42	42	45	ARM
55	42	47	49	53	54	52	52	52	52	OXF
35	23	27	26	27	27	24	26	27	26	PLY
45	43	38	39	43	44	42	42	42	41	UK

MEAN MINIMA

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
35	34	27	27	29	29	27	31	31	32	GOR
34	34	27	29	32	33	33	36	39	41	DUR
37	39	32	33	37	38	37	37	37	38	ARM
36	36	27	25	28	30	31	33	35	37	OXF
32	32	26	27	29	32	30	30	32	33	PLY
30	31	24	24	24	27	29	30	31	34	UK

Forecast Period 5 Years

5	10	15	20	25	30	35	40	45	50	
48	42	39	39	42	41	41	41	42	41	GOR
47	46	41	44	48	48	48	47	47	46	DUR
38	34	28	29	33	34	35	36	38	42	ARM
52	47	44	46	51	51	49	49	50	50	OXF
31	26	20	19	21	18	17	20	22	19	PLY
42	37	33	34	38	40	37	38	38	38	UK

5	10	15	20	25	30	35	40	45	50	
31	27	17	18	20	19	20	25	25	26	GOR
33	29	21	24	28	28	29	33	37	39	DUR
36	35	27	29	34	33	33	34	35	37	ARM
29	26	19	20	24	25	24	25	27	29	OXF
29	26	19	20	24	25	24	25	27	29	PLY
28	27	17	19	23	23	24	28	30	32	UK

Forecast Period 10 Years

5	10	15	20	25	30	35	40	45	50	
44	36	33	35	36	36	36	37	37	38	GOR
47	43	40	44	45	45	44	44	42	45	DUR
36	27	22	26	29	30	32	34	38	45	ARM
51	45	42	46	48	46	46	46	46	47	OXF
28	19	13	12	11	9	9	12	12	7	PLY
40	32	29	32	33	33	33	33	33	35	UK

5	10	15	20	25	30	35	40	45	50	
27	16	9	11	13	14	18	22	21	22	GOR
29	19	14	19	22	22	25	31	35	38	DUR
35	28	22	27	29	28	29	31	33	37	ARM
33	22	9	12	15	17	21	26	29	35	OXF
28	18	14	17	19	19	19	21	23	24	PLY
27	18	11	15	17	18	21	25	28	31	UK

Forecast Period 20 Years

5	10	15	20	25	30	35	40	45	50	
41	35	32	31	32	33	34	35	39	43	GOR
47	44	42	42	42	42	41	42	49	52	DUR
34	28	26	27	30	33	37	45	57	63	ARM
51	47	43	41	41	40	39	41	43	42	OXF
22	13	6	2	1	1	2	1	1	0	PLY
37	33	29	27	28	29	28	30	33	34	UK

5	10	15	20	25	30	35	40	45	50	
21	14	11	12	13	19	22	26	26	17	GOR
23	20	18	20	23	27	33	41	47	44	DUR
32	29	25	25	26	27	30	36	39	37	ARM
22	13	7	9	12	14	17	25	31	27	OXF
22	17	16	16	16	17	17	20	21	15	PLY
20	16	13	15	18	20	24	30	33	28	UK

TABLE V (e) - VALUE OF INDEX - MAY

Forecast Period 3 Years

MEAN MAXIMA — Averaging Period											MEAN MINIMA — Averaging Period										
	5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
GOR	53	49	48	43	41	41	44	39	32	35	GOR	36	30	27	26	26	27	29	25	28	30
DUR	49	49	51	47	43	41	43	38	36	37	DUR	31	25	22	22	23	21	22	21	21	23
ARM	37	30	29	28	29	28	31	29	26	28	ARM	25	19	18	16	17	15	16	10	10	11
OXF	43	44	44	44	43	41	38	28	30	31	OXF	22	21	21	23	24	20	18	15	16	16
PLY	41	38	41	38	34	31	31	31	31	29	PLY	21	19	20	19	20	18	15	8	10	12
UK	40	37	38	35	32	29	30	23	20	21	UK	21	17	15	14	15	13	13	8	9	11

Forecast Period 5 Years

	5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
GOR	48	44	41	33	31	31	32	26	16	20	GOR	27	20	17	16	15	17	18	15	19	19
DUR	46	46	46	41	35	33	33	29	26	26	DUR	24	16	13	14	13	10	12	11	10	13
ARM	29	21	19	19	20	19	21	18	18	21	ARM	19	11	9	8	7	5	4	1	1	1
OXF	39	39	38	38	36	33	24	12	15	17	OXF	10	11	12	14	14	9	7	4	4	4
PLY	33	32	34	31	25	21	19	19	24	22	PLY	17	14	15	14	15	11	5	2	3	3
UK	34	32	31	27	22	19	16	9	7	8	UK	13	9	7	6	6	4	3	1	1	1

Forecast Period 10 Years

	5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
GOR	45	38	30	18	16	16	16	15	10	10	GOR	23	13	11	9	9	10	10	12	15	15
DUR	47	45	42	32	25	23	22	24	21	24	DUR	18	9	6	7	5	3	3	2	2	3
ARM	23	13	11	10	11	12	13	13	16	19	ARM	13	6	4	3	2	1	0	0	0	0
OXF	40	37	37	24	31	22	8	6	8	11	OXF	11	11	12	14	11	6	3	1	1	1
PLY	33	33	31	23	17	11	9	14	14	17	PLY	16	13	12	11	11	5	1	0	0	0
UK	33	29	25	17	13	8	4	4	3	5	UK	11	6	4	4	2	1	0	0	0	0

Forecast Period 20 Years

	5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
GOR	37	21	9	2	0	0	0	0	0	0	GOR	21	12	8	8	9	11	13	14	17	11
DUR	45	38	28	16	8	9	15	19	22	24	DUR	16	8	5	5	2	1	1	1	0	1
ARM	19	9	7	7	7	8	9	12	17	20	ARM	12	4	2	1	0	0	0	0	0	0
OXF	41	35	31	26	15	4	2	3	4	3	OXF	13	13	13	12	6	1	0	0	0	0
PLY	34	28	19	9	3	1	3	7	6	3	PLY	16	12	11	10	7	2	0	0	0	0
UK	30	21	12	5	1	0	0	1	1	1	UK	9	5	3	2	0	0	0	0	0	0

TABLE V (f) - VALUE OF INDEX - JUNE

MEAN MAXIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
43	37	38	37	38	38	38	41	37	35	GOR
52	49	50	47	44	42	45	47	45	44	DUR
47	36	41	37	38	39	40	42	42	41	ARM
49	44	44	41	40	41	42	43	43	44	OXF
47	38	41	40	35	34	32	33	33	34	PLY
43	35	38	35	33	33	34	36	34	33	UK

Forecast Period 5 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
34	28	29	27	27	29	29	31	25	23	GOR
48	45	45	39	33	34	38	39	35	33	DUR
39	29	31	28	28	29	31	33	30	29	ARM
42	36	33	29	26	28	31	30	30	31	OXF
39	30	35	30	21	20	15	15	15	17	PLY
36	27	29	24	20	21	24	25	20	19	UK

Forecast Period 10 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
26	22	20	18	19	19	20	16	10	10	GOR
44	40	37	27	20	23	27	24	17	15	DUR
29	20	21	17	17	17	19	17	14	12	ARM
35	26	22	14	13	15	16	15	15	14	OXF
33	29	29	18	9	3	2	1	1	1	PLY
27	20	19	11	7	8	9	7	2	2	UK

Forecast Period 20 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
26	19	15	13	14	11	6	3	1	1	GOR
41	33	28	19	16	16	13	9	4	2	DUR
30	20	19	16	15	14	12	8	5	3	ARM
29	19	16	12	12	11	11	10	8	4	OXF
40	32	26	12	4	1	0	0	0	1	PLY
25	16	13	7	5	3	1	0	0	0	UK

MEAN MINIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
20	19	18	17	18	19	20	22	23	23	GOR
15	15	16	18	20	22	22	22	21	20	DUR
24	19	18	19	20	20	19	22	21	19	ARM
17	15	13	14	14	15	15	16	18	17	OXF
19	12	13	14	15	15	13	13	12	12	PLY
13	11	11	12	13	14	13	15	15	14	UK

Forecast Period 5 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
12	11	10	10	10	12	14	16	18	18	GOR
12	11	12	15	17	19	19	18	16	15	DUR
19	12	10	12	12	13	12	14	13	11	ARM
13	10	8	9	9	11	11	12	11	11	OXF
13	6	7	8	8	8	5	5	4	2	PLY
8	6	5	7	7	9	8	9	8	6	UK

Forecast Period 10 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
10	8	7	7	7	9	11	11	13	11	GOR
12	10	12	14	16	18	17	14	7	4	DUR
8	3	3	4	4	3	3	2	2	1	ARM
9	5	5	5	6	8	8	5	2	1	OXF
6	3	4	4	4	2	1	1	0	0	PLY
5	3	4	4	5	5	5	3	1	0	UK

Forecast Period 20 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
10	7	6	6	7	7	7	7	7	3	GOR
15	14	16	17	18	17	14	8	1	0	DUR
8	3	3	3	3	2	0	0	0	0	ARM
9	6	6	7	8	4	1	0	0	0	OXF
9	6	6	4	3	1	0	0	0	0	PLY
7	5	5	5	5	4	1	0	0	0	UK

TABLE V (g) – VALUE OF INDEX – JULY

Forecast Period 3 Years

MEAN MAXIMA

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
48	41	42	40	38	39	41	43	42	42	GOR
48	43	45	44	44	43	42	40	41	39	DUR
35	27	26	23	22	23	24	24	26	27	ARM
56	53	53	49	46	45	45	44	45	44	OXF
48	42	37	37	34	35	37	38	39	37	PLY
43	36	35	32	31	31	32	32	33	32	UK

MEAN MINIMA

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
30	28	30	32	36	39	42	45	42	40	GOR
29	28	29	25	23	25	26	26	25	25	DUR
25	22	24	19	16	18	21	23	21	18	ARM
23	19	19	16	13	13	13	13	13	13	OXF
19	15	15	15	13	13	15	17	14	15	PLY
19	16	17	15	14	17	19	21	19	18	UK

Forecast Period 5 Years

5	10	15	20	25	30	35	40	45	50	
43	34	35	31	31	31	34	36	35	32	GOR
44	37	37	38	38	36	35	33	34	30	DUR
27	18	15	12	11	12	12	12	14	13	ARM
52	47	44	37	34	34	31	31	31	29	OXF
40	30	24	22	17	21	22	25	26	27	PLY
37	28	25	21	18	19	19	21	21	19	UK

5	10	15	20	25	30	35	40	45	50	
26	23	27	30	35	39	41	44	41	35	GOR
27	23	24	19	18	20	20	21	20	18	DUR
20	18	18	13	11	12	16	18	15	9	ARM
19	13	12	9	7	8	7	8	8	6	OXF
13	8	8	7	7	8	10	12	9	9	PLY
16	12	13	11	11	13	16	18	16	12	UK

Forecast Period 10 Years

5	10	15	20	25	30	35	40	45	50	
34	26	23	18	17	19	22	24	20	17	GOR
40	33	34	36	34	31	28	27	25	23	DUR
18	7	3	1	1	1	1	1	1	1	ARM
48	43	35	27	24	22	20	20	16	15	OXF
33	17	13	9	8	10	12	15	17	16	PLY
28	18	13	9	7	7	7	8	6	5	UK

5	10	15	20	25	30	35	40	45	50	
23	23	27	32	37	41	43	43	38	31	GOR
21	17	15	14	11	11	11	12	10	6	DUR
20	16	13	7	6	9	12	14	8	3	ARM
14	9	6	3	3	3	2	3	1	1	OXF
8	4	3	3	3	5	7	7	4	3	PLY
11	9	8	7	8	10	13	14	10	5	UK

Forecast Period 20 Years

5	10	15	20	25	30	35	40	45	50	
27	11	5	4	4	5	4	2	1	1	GOR
41	34	34	33	28	23	17	13	10	9	DUR
12	3	1	0	0	0	0	0	0	0	ARM
47	37	26	19	15	12	9	8	8	8	OXF
28	10	4	4	3	4	5	8	9	4	PLY
29	9	4	2	1	1	0	0	0	0	UK

5	10	15	20	25	30	35	40	45	50	
30	31	34	38	42	43	42	39	31	20	GOR
18	11	8	6	5	4	3	3	2	1	DUR
16	9	5	3	5	6	7	5	2	1	ARM
14	7	3	2	2	1	1	0	0	0	OXF
6	1	1	1	2	2	2	1	0	0	PLY
11	7	5	6	7	8	9	7	4	2	UK

TABLE V (h) - VALUE OF INDEX - AUGUST

MEAN MAXIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
46	43	42	40	42	44	44	41	41	43	GOR
48	44	43	41	41	42	42	40	39	40	DUR
45	40	42	39	41	40	38	35	37	40	ARM
50	49	49	48	49	50	50	49	50	51	OXF
42	35	33	31	30	29	30	29	31	32	PLY
42	36	36	33	35	36	35	33	34	35	UK

Forecast Period 5 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
42	35	35	33	35	38	37	33	34	35	GOR
43	37	35	31	31	33	33	29	30	29	DUR
38	32	33	30	32	30	26	23	27	32	ARM
45	42	41	42	44	45	45	44	46	45	OXF
35	24	21	19	17	18	19	17	19	21	PLY
36	28	27	25	28	29	29	25	27	27	UK

Forecast Period 10 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
33	25	24	25	28	29	26	25	24	17	GOR
37	27	25	23	24	25	23	20	19	14	DUR
33	26	24	23	22	16	15	17	22	23	ARM
42	37	37	39	41	41	40	40	41	36	OXF
25	9	7	6	7	7	7	8	9	12	PLY
28	19	18	19	22	21	20	19	19	16	UK

Forecast Period 20 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
30	23	23	23	20	17	15	15	12	5	GOR
34	25	24	22	19	17	14	13	11	5	DUR
31	23	18	12	9	8	11	16	18	14	ARM
43	40	39	38	36	34	35	37	36	26	OXF
20	5	2	2	2	2	2	3	4	4	PLY
27	19	17	16	14	12	12	13	13	7	UK

MEAN MINIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
26	27	25	25	27	30	29	29	30	30	GOR
26	23	22	20	21	22	20	17	17	21	DUR
21	11	12	11	11	13	8	8	9	10	ARM
21	19	16	14	16	16	13	12	12	14	OXF
23	19	17	15	17	16	15	11	7	7	PLY
19	15	14	12	14	15	13	11	11	13	UK

Forecast Period 5 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
24	23	20	19	23	27	25	26	27	25	GOR
21	16	14	11	13	15	14	10	12	15	DUR
11	3	3	3	4	6	4	5	5	6	ARM
16	12	7	6	8	9	7	5	7	8	OXF
15	10	8	7	8	8	7	4	3	3	PLY
13	9	7	5	8	10	8	7	9	9	UK

Forecast Period 10 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
21	17	14	16	21	23	24	26	24	17	GOR
15	8	5	5	7	7	5	4	6	5	DUR
5	1	1	1	2	3	3	4	5	4	ARM
12	5	2	2	3	2	2	3	4	3	OXF
9	3	2	2	3	2	2	3	2	1	PLY
7	3	2	2	4	4	5	6	6	4	UK

Forecast Period 20 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
18	16	17	20	24	26	25	24	18	10	GOR
9	4	3	3	3	2	1	1	1	1	DUR
5	1	1	2	2	3	3	4	3	2	ARM
7	3	1	1	1	1	2	3	3	1	OXF
7	2	1	1	1	1	1	1	1	0	PLY
5	2	2	2	3	3	3	5	4	2	UK

TABLE V (i) - VALUE OF INDEX - SEPTEMBER

MEAN MAXIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
35	27	27	29	29	29	30	28	22	22	GOR
40	34	33	31	32	32	34	35	33	34	DUR
32	27	27	26	26	27	28	28	27	29	ARM
46	40	38	37	38	38	39	40	40	36	OXF
39	30	30	27	28	28	30	30	32	29	PLY
34	26	25	24	24	24	25	25	23	23	UK

Forecast Period 5 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
23	16	17	19	21	20	20	17	10	9	GOR
28	23	21	19	22	22	24	24	23	24	DUR
21	14	16	15	15	15	14	14	14	17	ARM
23	27	23	22	25	24	24	25	24	24	OXF
26	14	14	11	13	12	14	15	14	14	PLY
21	13	11	10	12	11	11	10	8	9	UK

Forecast Period 10 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
16	11	14	15	17	17	14	7	2	1	GOR
23	16	13	14	15	17	18	17	14	15	DUR
14	10	9	8	8	7	6	4	1	3	ARM
27	16	13	14	15	14	14	14	13	10	OXF
13	3	2	2	2	2	2	2	2	1	PLY
13	5	4	4	4	3	3	1	0	1	UK

Forecast Period 20 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
18	15	16	18	18	13	8	3	0	0	GOR
21	16	16	16	17	17	17	15	11	7	DUR
16	10	8	6	5	4	2	0	0	0	ARM
23	16	13	13	12	10	9	9	8	3	OXF
9	2	1	1	1	1	1	1	0	0	PLY
11	5	3	3	2	1	0	0	0	0	UK

MEAN MINIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
29	25	25	25	28	30	31	33	38	37	GOR
30	20	22	22	25	27	27	29	31	35	DUR
30	20	18	17	19	21	21	22	24	27	ARM
30	21	20	21	24	27	29	32	35	38	OXF
33	25	24	24	27	29	30	32	34	34	PLY
24	15	15	15	18	20	22	25	28	31	UK

Forecast Period 5 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
19	16	17	19	21	23	26	30	34	33	GOR
24	14	17	17	21	21	22	24	27	31	DUR
20	11	11	9	12	13	14	16	19	22	ARM
25	13	14	15	18	21	23	27	31	34	OXF
29	19	18	17	20	22	23	25	27	25	PLY
15	8	9	9	12	14	16	19	23	25	UK

Forecast Period 10 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
14	12	13	16	18	21	25	30	32	28	GOR
12	8	10	13	15	15	15	14	10	11	DUR
9	4	3	4	5	7	8	9	12	15	ARM
11	3	5	7	10	13	16	20	24	23	OXF
16	7	5	6	8	9	11	13	13	5	PLY
7	3	3	6	7	9	11	12	14	12	UK

Forecast Period 20 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
13	13	15	19	22	27	32	36	35	20	GOR
17	13	15	17	17	18	17	12	6	4	DUR
10	5	5	5	6	7	8	10	15	15	ARM
13	7	10	13	17	21	25	30	36	31	OXF
13	6	5	6	8	8	9	10	9	4	PLY
9	6	7	9	11	12	13	14	17	11	UK

TABLE V (5) - VALUE OF INDEX - OCTOBER

MEAN MAXIMA

Averaging Period										
	5	10	15	20	25	30	35	40	45	50
Forecast Period 3 Years										
GOR	43	39	39	40	40	40	39	36	38	40
DUR	43	36	35	33	34	34	37	36	39	43
ARM	36	28	30	27	29	28	29	27	30	34
OXF	45	39	38	36	36	36	38	33	35	37
PLY	36	31	31	26	26	24	25	18	16	16
UK	36	29	29	27	27	26	27	23	26	30
Forecast Period 5 Years										
GOR	33	27	29	31	32	33	33	32	34	38
DUR	32	22	22	20	21	24	27	28	33	40
ARM	24	15	17	15	17	16	19	19	23	29
OXF	35	25	25	21	21	23	25	22	24	29
PLY	27	20	21	14	13	11	12	8	5	6
UK	25	17	17	16	16	16	18	16	20	26
Forecast Period 10 Years										
GOR	26	23	28	30	30	30	29	30	31	39
DUR	16	9	9	8	11	15	18	22	30	44
ARM	10	7	8	7	7	7	9	9	13	19
OXF	20	12	9	6	6	7	9	4	8	15
PLY	18	13	11	6	4	3	2	0	0	0
UK	15	10	11	9	8	9	9	7	9	12
Forecast Period 20 Years										
GOR	34	32	34	33	30	28	27	29	36	56
DUR	18	11	12	12	15	19	23	33	54	76
ARM	14	11	11	9	8	7	8	10	13	37
OXF	20	11	8	4	3	2	3	1	3	16
PLY	20	15	11	5	2	0	0	0	0	0
UK	19	13	14	11	8	6	5	6	5	17

MEAN MINIMA

Averaging Period										
	5	10	15	20	25	30	35	40	45	50
Forecast Period 3 Years										
GOR	29	24	19	21	24	27	32	32	40	46
DUR	43	37	37	37	36	35	35	37	41	47
ARM	43	38	37	36	36	36	38	37	41	45
OXF	49	44	45	45	43	41	42	41	44	47
PLY	42	38	40	35	35	32	33	34	37	40
UK	34	29	29	29	28	27	29	31	37	43
Forecast Period 5 Years										
GOR	21	13	10	13	17	23	29	31	42	50
DUR	35	29	31	31	28	28	29	33	40	48
ARM	33	27	27	25	25	27	31	31	37	45
OXF	41	35	37	37	33	31	32	34	38	42
PLY	33	27	28	23	22	20	22	26	31	44
UK	23	18	20	19	18	19	23	27	35	43
Forecast Period 10 Years										
GOR	12	5	3	6	12	15	22	33	48	64
DUR	25	23	25	23	20	21	26	33	44	61
ARM	24	20	21	19	19	21	23	26	38	57
OXF	30	29	30	27	21	20	24	28	34	39
PLY	21	19	18	13	8	4	8	14	23	26
UK	14	12	14	11	9	10	14	19	30	44
Forecast Period 20 Years										
GOR	14	8	8	12	20	30	42	56	80	92
DUR	29	25	25	24	24	28	33	43	65	92
ARM	28	26	27	26	24	24	29	45	79	91
OXF	34	29	24	18	15	16	20	23	25	30
PLY	28	23	19	11	6	5	13	21	29	29
UK	18	16	16	12	10	12	17	25	41	73

TABLE V (k) - VALUE OF INDEX - NOVEMBER

MEAN MAXIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
38	36	37	34	35	31	32	29	27	29	GOR
33	31	32	32	34	33	33	29	23	23	DUR
32	25	28	27	29	29	30	29	29	29	ARM
44	38	38	39	39	39	39	37	37	33	OXF
34	25	28	27	28	28	28	27	24	22	PLY
32	26	28	27	28	28	28	25	23	22	UK

Forecast Period 5 Years

5	10	15	20	25	30	35	40	45	50	
30	29	28	26	27	26	27	23	21	22	GOR
25	24	23	25	27	28	28	23	19	18	DUR
24	17	18	19	22	23	24	23	23	23	ARM
36	28	27	29	30	31	31	28	26	22	OXF
25	14	16	17	18	18	17	16	14	12	PLY
23	17	17	18	21	21	21	17	16	15	UK

Forecast Period 10 Years

5	10	15	20	25	30	35	40	45	50	
29	25	21	20	20	19	17	12	12	12	GOR
23	21	21	23	25	25	22	16	15	14	DUR
18	12	12	14	15	15	15	14	14	16	ARM
27	19	19	21	22	22	20	19	17	12	OXF
12	6	8	9	9	8	6	4	4	4	PLY
16	12	12	14	15	14	12	9	8	8	UK

Forecast Period 20 Years

5	10	15	20	25	30	35	40	45	50	
20	14	14	14	11	6	3	1	0	0	GOR
26	24	24	24	22	18	15	12	11	9	DUR
16	11	10	9	9	8	7	7	7	7	ARM
29	22	21	21	19	18	17	18	16	9	OXF
17	10	9	8	6	4	3	2	3	2	PLY
18	13	13	13	11	8	6	3	3	2	UK

MEAN MINIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
34	27	28	28	28	24	24	22	22	20	GOR
37	37	39	40	43	43	44	40	37	37	DUR
43	39	40	38	39	37	37	36	36	38	ARM
43	39	39	40	41	40	41	35	33	34	OXF
44	40	41	43	44	46	47	48	48	47	PLY
35	31	32	33	34	34	34	32	31	31	UK

Forecast Period 5 Years

5	10	15	20	25	30	35	40	45	50	
23	19	17	18	17	14	14	12	13	9	GOR
30	30	32	35	38	39	39	34	31	30	DUR
35	31	28	28	29	28	29	28	28	30	ARM
32	26	27	29	31	32	32	22	22	21	OXF
34	29	31	33	37	39	41	42	43	41	PLY
24	21	21	23	26	26	27	24	23	22	UK

Forecast Period 10 Years

5	10	15	20	25	30	35	40	45	50	
19	13	11	11	9	7	6	5	4	2	GOR
31	31	32	35	37	38	35	29	29	27	DUR
31	25	21	21	21	21	20	19	21	21	ARM
27	22	23	26	27	27	22	16	13	10	OXF
30	25	27	31	33	36	37	39	42	37	PLY
21	17	18	21	22	23	22	19	19	17	UK

Forecast Period 20 Years

5	10	15	20	25	30	35	40	45	50	
16	11	10	9	5	2	1	0	0	0	GOR
34	33	33	34	33	29	27	27	28	24	DUR
22	14	12	13	11	9	9	9	7	6	ARM
31	27	28	28	26	23	21	13	9	5	OXF
33	31	32	34	36	39	44	50	52	44	PLY
23	20	21	22	21	19	19	17	16	11	UK

TABLE V (1) - VALUE OF INDEX - DECEMBER

MEAN MAXIMA

MEAN MINIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
48	42	40	40	39	39	38	40	39	38	GOR
52	48	45	43	44	43	43	42	42	44	DUR
47	40	38	36	35	36	35	36	36	37	ARM
59	55	53	51	52	49	49	48	47	49	OXF
46	43	40	39	39	37	37	39	37	37	PLY
48	43	40	39	38	37	37	38	37	38	UK

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
48	41	40	41	40	41	41	43	43	41	GOR
48	48	46	44	45	44	44	44	45	48	DUR
51	47	46	45	42	44	44	46	46	46	ARM
59	55	53	52	53	49	49	48	48	49	OXF
52	49	45	44	45	41	40	40	40	43	PLY
48	44	41	40	40	39	39	39	40	41	UK

Forecast Period 5 Years

5	10	15	20	25	30	35	40	45	50	
43	31	29	28	28	28	27	28	28	26	GOR
47	40	35	33	34	32	32	30	31	33	DUR
43	31	28	26	25	26	26	25	26	26	ARM
55	47	42	41	42	36	35	31	32	35	OXF
42	35	30	29	29	25	26	26	25	27	PLY
43	32	28	27	27	25	25	23	23	25	UK

5	10	15	20	25	30	35	40	45	50	
42	30	28	29	28	31	31	32	33	28	GOR
47	44	40	38	39	37	37	37	39	41	DUR
49	40	39	37	35	37	37	38	39	37	ARM
56	49	44	44	45	38	37	35	35	37	OXF
49	43	37	35	37	29	30	28	31	33	PLY
45	36	33	31	31	29	29	29	31	31	UK

Forecast Period 10 Years

5	10	15	20	25	30	35	40	45	50	
26	5	6	4	3	3	3	4	3	5	GOR
37	21	15	14	12	11	9	10	12	17	DUR
30	10	8	4	3	4	5	5	5	7	ARM
47	33	28	28	25	18	14	12	14	18	OXF
34	21	17	16	13	11	11	11	9	9	PLY
31	13	11	9	6	5	5	5	6	9	UK

5	10	15	20	25	30	35	40	45	50	
27	6	8	7	7	9	9	11	11	8	GOR
41	30	25	24	23	21	19	21	24	28	DUR
38	21	20	13	11	15	17	18	17	18	ARM
49	35	30	30	26	19	15	14	15	18	OXF
44	31	22	21	17	13	12	12	17	19	PLY
34	18	15	12	10	9	9	11	13	15	UK

Forecast Period 20 Years

5	10	15	20	25	30	35	40	45	50	
18	1	1	0	0	0	0	0	0	0	GOR
29	13	7	3	2	1	1	1	3	4	DUR
23	3	1	0	0	0	1	0	1	1	ARM
42	29	20	16	9	1	0	0	0	1	OXF
28	15	8	6	4	2	1	0	0	0	PLY
22	7	2	1	0	0	0	0	0	0	UK

5	10	15	20	25	30	35	40	45	50	
16	2	3	3	3	3	4	3	3	0	GOR
27	19	13	7	4	1	2	4	8	9	DUR
28	8	6	2	3	4	5	3	4	4	ARM
44	33	25	20	13	4	1	0	0	0	OXF
39	25	14	9	5	1	2	2	5	7	PLY
23	9	5	2	1	0	0	0	1	1	UK

TABLE V (m) -- VALUE OF INDEX - WINTER

MEAN MAXIMA

MEAN MINIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
52	45	43	44	43	44	46	47	47	47	GOR
56	52	49	51	49	50	51	50	52	52	DUR
50	44	41	42	41	43	43	41	40	41	ARM
65	62	60	61	60	61	61	60	60	61	OXF
54	52	49	51	50	51	52	51	50	51	PLY
52	48	45	47	46	47	48	46	46	47	UK

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
50	45	45	47	48	50	51	51	50	50	GOR
53	52	49	50	48	50	49	49	51	52	DUR
49	46	45	46	45	47	49	49	47	49	ARM
63	60	58	59	59	59	59	58	59	59	OXF
56	54	50	51	51	52	52	49	50	53	PLY
49	47	44	45	45	46	46	45	45	46	UK

Forecast Period 5 Years

5	10	15	20	25	30	35	40	45	50	
43	31	29	29	29	29	31	31	31	30	GOR
46	35	31	33	31	32	32	31	32	32	DUR
41	31	27	29	29	29	31	26	23	23	ARM
58	52	48	49	49	49	49	47	46	47	OXF
48	43	39	41	41	41	43	41	38	39	PLY
43	33	30	33	32	33	34	31	29	30	UK

5	10	15	20	25	30	35	40	45	50	
44	37	37	39	41	43	44	43	41	40	GOR
49	41	39	39	37	38	36	37	39	40	DUR
43	37	36	37	36	39	42	39	37	39	ARM
58	51	47	49	50	49	47	46	45	45	OXF
49	45	38	39	41	40	41	36	37	41	PLY
42	35	33	34	34	35	35	33	32	33	UK

Forecast Period 10 Years

5	10	15	20	25	30	35	40	45	50	
28	12	11	10	9	11	12	12	11	11	GOR
31	13	12	12	10	11	9	8	9	10	DUR
29	13	13	13	13	15	15	9	7	8	ARM
51	38	35	35	35	35	35	31	30	32	OXF
41	29	28	28	27	30	31	28	27	30	PLY
31	17	17	17	16	18	18	15	14	16	UK

5	10	15	20	25	30	35	40	45	50	
37	26	26	28	32	34	35	33	31	30	GOR
37	26	23	20	20	17	14	17	19	20	DUR
35	25	25	24	25	30	32	29	30	33	ARM
52	40	37	39	39	36	33	30	29	29	OXF
45	34	27	29	30	30	29	24	27	23	PLY
33	22	20	21	22	22	21	19	19	20	UK

Forecast Period 20 Years

5	10	15	20	25	30	35	40	45	50	
26	10	9	10	9	8	8	5	4	3	GOR
31	13	7	8	5	4	3	1	2	2	DUR
25	11	9	10	10	8	6	1	1	1	ARM
48	38	32	34	31	27	26	16	15	13	OXF
37	29	24	26	26	24	24	19	13	14	PLY
29	17	14	16	14	12	10	5	3	3	UK

5	10	15	20	25	30	35	40	45	50	
31	22	26	29	30	30	28	23	21	20	GOR
34	21	16	13	7	5	4	4	5	6	DUR
32	24	23	26	27	27	28	25	27	30	ARM
51	45	40	38	35	30	27	24	19	12	OXF
45	37	30	32	30	27	27	18	16	12	PLY
32	24	21	22	20	18	16	11	11	9	UK

TABLE V (h) - VALUE OF INDEX - SPRING

MEAN MAXIMA

MEAN MINIMA

Forecast Period 3 Years

Averaging Period											Averaging Period										
5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
52	49	45	43	44	45	45	46	46	47	GOR	39	33	30	30	32	35	37	38	41	45
51	51	46	48	49	51	52	53	53	53	DUR	37	31	27	31	31	31	32	34	37	43
38	38	32	35	39	41	43	45	47	49	ARM	30	29	25	27	30	32	34	36	38	41
55	51	41	43	46	48	48	49	51	52	OXF	39	33	26	28	27	25	35	23	25	28
41	38	37	35	35	34	33	34	36	33	PLY	37	30	23	25	27	28	29	28	30	33
45	43	36	37	39	41	41	42	42	43	UK	31	26	19	22	23	24	24	25	28	33

Forecast Period 5 Years

5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
45	40	34	33	34	35	36	37	37	39	GOR	26	21	17	19	20	23	28	32	35	39
47	45	40	41	43	44	46	47	47	48	DUR	29	22	17	22	22	21	23	27	33	40
36	33	26	30	35	37	39	41	45	49	ARM	23	24	19	21	25	26	29	32	35	39
52	44	33	36	40	40	41	43	45	46	OXF	29	23	14	17	17	12	15	15	17	22
36	32	29	27	27	23	22	25	28	26	PLY	31	22	13	16	19	18	20	22	24	27
41	36	28	29	32	32	33	34	36	37	UK	21	16	9	12	14	13	16	19	23	29

Forecast Period 10 Years

5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
41	32	29	27	29	30	31	33	34	37	GOR	21	14	13	14	19	24	29	34	38	40
47	42	41	41	42	43	44	46	47	49	DUR	21	11	11	13	13	15	18	23	32	35
36	28	25	30	34	36	39	43	50	55	ARM	23	19	16	19	21	23	27	31	36	40
48	36	31	35	36	36	37	39	41	44	OXF	22	12	7	10	8	7	8	8	12	17
34	26	25	21	17	13	13	17	20	19	PLY	24	9	6	9	11	12	14	16	19	19
39	29	25	27	27	27	29	31	33	35	UK	17	7	5	7	8	10	13	18	24	28

Forecast Period 20 Years

5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
36	26	23	21	22	25	28	32	36	37	GOR	22	17	16	23	30	36	42	47	50	49
48	43	40	39	40	42	45	49	56	58	DUR	22	14	12	15	16	20	26	36	49	55
35	31	31	34	38	44	53	65	73	75	ARM	19	17	16	19	22	26	33	43	47	47
46	36	29	27	27	29	31	34	37	35	OXF	19	11	5	6	3	0	0	0	0	2
29	21	12	4	1	1	2	4	5	4	PLY	20	10	7	11	13	13	17	18	20	18
35	27	22	20	21	23	25	29	34	34	UK	14	8	6	8	9	11	17	25	32	34

TABLE V (o) - VALUE OF INDEX - SUMMER

MEAN MAXIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
48	42	42	41	42	43	43	42	42	42	GOR
55	52	52	52	50	49	49	49	49	47	DUR
43	38	39	36	37	38	39	38	39	41	ARM
57	53	52	51	52	52	52	52	54	55	OXF
49	40	35	38	32	33	33	36	38	37	PLY
45	38	37	35	36	37	36	36	37	37	UK

Forecast Period 5 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
42	34	34	33	35	36	35	32	33	29	GOR
51	47	46	46	44	44	44	42	42	37	DUR
34	29	28	27	28	29	28	27	31	31	ARM
51	46	42	43	44	46	45	45	47	45	OXF
42	26	22	24	14	18	17	20	24	25	PLY
39	29	27	27	27	29	28	27	27	24	UK

Forecast Period 10 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
30	23	23	23	25	25	20	17	5	6	GOR
47	43	44	43	41	40	39	36	32	29	DUR
30	23	21	20	21	20	19	21	24	23	ARM
47	40	38	40	41	42	39	40	40	36	OXF
31	12	13	10	5	5	5	9	11	15	PLY
29	19	19	20	21	21	18	16	14	10	UK

Forecast Period 20 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
28	22	22	21	17	12	8	6	4	0	GOR
49	45	45	43	39	35	30	27	24	15	DUR
27	21	18	15	14	14	15	19	21	15	ARM
48	43	41	41	39	37	38	37	37	28	OXF
33	14	10	7	2	3	1	3	5	8	PLY
29	21	21	21	17	14	10	9	7	3	UK

MEAN MINIMA

Forecast Period 3 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
31	31	32	33	37	40	42	44	44	44	GOR
25	24	26	26	27	29	29	27	28	30	DUR
21	15	17	15	16	19	20	23	23	22	ARM
20	19	17	16	18	18	19	20	23	23	OXF
17	15	15	15	16	16	18	18	17	16	PLY
17	15	16	15	17	20	21	22	23	23	UK

Forecast Period 5 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
27	27	27	30	34	38	40	42	43	39	GOR
21	20	21	22	25	27	26	23	25	26	DUR
13	9	9	9	11	13	15	17	19	14	ARM
17	15	10	11	13	15	15	15	19	17	OXF
10	7	7	7	9	11	11	12	11	7	PLY
12	10	10	11	14	17	17	19	21	18	UK

Forecast Period 10 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
27	25	27	31	36	39	41	43	41	33	GOR
18	17	18	20	23	23	19	18	19	15	DUR
10	6	6	7	9	10	12	15	14	9	ARM
15	10	7	9	11	12	12	13	15	10	OXF
8	5	5	5	7	9	9	9	7	3	PLY
9	8	8	10	13	15	15	18	18	11	UK

Forecast Period 20 Years

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
31	32	35	38	42	44	45	44	39	29	GOR
22	20	21	21	20	19	17	15	16	12	DUR
12	8	8	10	11	13	15	15	14	8	ARM
15	12	10	11	12	13	12	15	18	12	OXF
7	5	5	6	6	6	5	4	2	0	PLY
12	11	11	13	14	15	17	18	16	9	UK

TABLE V (p) - VALUE OF INDEX - AUTUMN

MEAN MAXIMA

MEAN MINIMA

Forecast Period 3 Years

Averaging Period											Averaging Period										
5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
44	37	39	38	37	38	40	38	36	36	GOR	29	21	22	23	26	26	31	35	43	43
44	37	39	36	38	39	41	42	43	45	DUR	39	33	37	38	41	43	44	44	46	50
41	32	35	32	33	35	37	36	38	40	ARM	44	37	36	34	34	36	38	38	41	44
50	43	43	41	41	42	43	44	47	43	OXF	40	35	37	36	37	38	40	40	45	49
44	35	35	29	30	30	32	39	30	26	PLY	45	41	43	42	43	44	46	48	51	51
41	32	33	29	29	30	31	31	32	33	UK	34	27	29	28	29	31	35	37	43	47

Forecast Period 5 Years

5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
33	27	27	28	30	32	33	32	29	30	GOR	17	11	12	15	19	21	27	33	44	43
30	25	25	24	28	30	33	35	40	47	DUR	29	26	31	33	36	39	39	41	50	58
29	19	22	19	22	23	25	26	29	33	ARM	34	26	24	21	25	28	30	32	36	41
38	29	27	26	29	29	30	33	35	34	OXF	34	27	28	29	31	32	34	37	44	48
32	19	19	12	14	11	13	12	12	10	PLY	38	31	33	32	36	38	40	44	48	47
28	18	18	15	17	17	19	20	22	25	UK	22	16	18	19	22	25	29	35	44	49

Forecast Period 10 Years

5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
27	24	24	25	28	29	29	27	25	26	GOR	11	7	9	14	17	22	29	40	51	54
25	20	21	24	27	30	32	37	46	53	DUR	24	26	31	33	36	37	39	45	62	69
17	12	12	12	14	15	16	19	23	29	ARM	24	16	14	15	19	23	26	31	39	45
28	18	16	18	19	20	23	27	29	28	OXF	23	20	21	23	24	26	30	39	55	64
18	6	3	1	0	0	0	0	0	0	PLY	27	23	23	25	28	31	36	44	49	45
18	10	9	9	10	11	11	12	13	17	UK	14	11	14	17	20	24	30	39	53	57

Forecast Period 20 Years

5	10	15	20	25	30	35	40	45	50		5	10	15	20	25	30	35	40	45	50
27	24	27	29	30	29	27	25	24	24	GOR	15	14	17	23	30	40	54	70	87	92
28	25	27	29	32	36	42	52	68	68	DUR	33	34	36	38	40	43	50	67	89	88
21	15	15	15	16	18	20	23	33	38	ARM	23	18	18	20	25	32	40	58	67	69
29	21	19	19	22	26	32	37	38	31	OXF	27	23	24	25	28	34	44	66	93	94
16	5	1	0	0	0	0	0	0	0	PLY	32	28	28	31	36	44	54	60	62	58
19	12	11	11	11	12	11	10	13	17	UK	20	19	21	25	29	37	50	68	82	81

TABLE V (σ) -- VALUE OF INDEX -- YEAR

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
51	49	49	50	51	53	54	55	57	60	GOR
54	51	49	52	52	54	55	55	57	59	DUR
38	35	35	35	37	40	42	43	46	50	ARM
59	55	49	48	48	47	46	46	49	52	OXF
52	44	41	43	44	44	45	43	44	46	PLY
48	43	40	42	43	44	44	45	47	51	UK

FORECAST PERIOD
3 YEARS

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
42	38	37	38	40	42	44	46	49	50	GOR
50	46	43	46	47	50	49	51	53	56	DUR
31	27	26	28	31	34	37	39	43	46	ARM
56	48	37	37	38	35	34	37	41	44	OXF
46	33	29	31	33	32	34	34	35	37	PLY
42	34	28	31	32	34	35	37	41	43	UK

FORECAST PERIOD
5 YEARS

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
33	21	23	24	29	33	35	39	41	38	GOR
45	37	39	41	43	45	45	47	53	54	DUR
27	23	24	27	30	33	36	40	45	48	ARM
50	35	24	25	23	22	24	28	33	34	OXF
33	13	13	16	18	20	21	20	21	20	PLY
33	19	19	21	24	26	28	32	36	36	UK

FORECAST PERIOD
10 YEARS

Averaging Period										
5	10	15	20	25	30	35	40	45	50	
26	20	23	27	32	37	43	45	47	41	GOR
47	42	42	43	44	47	53	61	67	65	DUR
32	30	30	32	36	42	49	55	58	57	ARM
49	39	26	24	25	26	32	37	41	38	OXF
30	18	14	18	19	18	19	15	15	12	PLY
32	24	21	23	26	30	36	40	43	40	UK

FORECAST PERIOD
20 YEARS

TABLE VI

Optimum averaging period (years) for temperatures in the UK

TIME AVERAGE	MAXIMA	MINIMA
10 days	45	40
Month	35	30
Season	25	20
Year	15	

Results are based on data from 5 stations in the UK for the period 1882-1976